THE

ELECTRICAL REVIEW.

VOL. LXVI. APRIL 22, 1910. No. 1,691.

ELECTRICAL REVIEW.

Vol. LXVI.] CONTENTS: April 22, 1910. [No. 1,691.

	Page
Inspection of Coal Mines	625
Electrical Affairs in India	626
Copper	626
As Others See Us	627
The L.U.T. and Renewals	627
Commercial Morality	627
Electricity in Mining	628
The Installation and Management of Electrical Plant in Coal Mines	630
The Supply of Electricity by Private Persons	632
Correspondence:—	
The Imperial College of Science	633
Electric Smelting Furnace	633
Sale of Scrap Metal	633
Contracts in India	633
Ringing Bells Automatically	633
Protection and the Electrical Industry	634
Publicity Literature	634
Cost of Living in the Malay States	634
Electrically-driven Steamships	635
The Need for British Trade Agression in Turkey	635
New Electrical Devices, Fittings and Plant (*illus.*)	635
Legal	636
Our Legal Query Column	637
Business Notes	637
Notes	642
Electrical Machinery and Apparatus for Use in Mines (*illus.*)	643
Adams Manufacturing Co.'s "Igranic" Electrical Works (*illus.*)	653
City Notes	658
Electric Tramway and Railway Traffic Returns	664
Stocks and Shares	662
Share List of Electrical Companies	663
Proceedings of Institutions:—	
Some Notes on Standardisation of Electrical Machines	665
Rating and Testing of Motors for Intermittent Working	667
Parliamentary	668
Foreign and Colonial Tariffs on Electrical Goods	671
New Patents Applied For, 1910	671
Expiring Patents	672
Published Specifications	672
Contractors' Column	Advertisement pages xxii and xxiv

THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 4d.

The Oldest Weekly Electrical Paper. *Established 1872.*

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE:—4, LUDGATE HILL, LONDON, E.C.

Telegraphic Address.: "AGEEKAY, LONDON." Code, A B C.

Telephone Nos.: Holborn 933; Central 4425 (Editorial only).

ALL Letters should be addressed to the Proprietors, H. Alabaster, Gatehouse & Co.

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SUBSCRIPTION RATES.—Per annum, postage inclusive, in Great Britain, 19s. 6d.; Canada, £1 1s. 8d. ($5.30). To all other countries, £1 10s.

BINDING.—Subscribers' numbers bound, including case, for 4s. each volume.

CASES.—Cloth Cases for Binding can be had, price 2s. 6d. each; post free 2s 9d.

FOREIGN AGENTS.—New York: D. VAN NOSTRAND, 23, Murray Street. TORONTO, ONT.: WM. DAWSON & SONS, LTD., Manning Chambers. PARIS: BOYVEAU & CHEVILLET, 22, Rue de la Banque. Berlin: ASHER & Co., Unter den Linden.

Cheques and Postal Orders (on Chief Office, London) to be made payable to Mr. H. ALABASTER, 4, Ludgate Hill, E.C.

THE

UNIVERSAL ELECTRICAL DIRECTORY

(J. A. BERLY'S).

1910 EDITION

H. ALABASTER, GATEHOUSE & CO.,

4, Ludgate Hill, London, E.C.

INSPECTION OF COAL MINES.

LAST week the Home Secretary officially notified changes in the organisation of the Mines Inspection Districts, as recommended by the Royal Commission on Mines, which will take effect on June 1st next.

At present there are 12 inspection districts, but these are to be reduced to eight, viz.: (1) Scotland, which will include the two existing districts; (2) Newcastle and (3) Durham, both of which remain as at present; (4) Yorkshire and North Midland, which includes the present Yorkshire district, and the Counties of Nottingham and Derby; (5) Manchester and Ireland, which is unaltered; (6) Liverpool and North Wales, also unaltered; (7) South Wales, comprising the two South Wales districts, and Monmouthshire; (8) Midland and Southern, which embraces the existing Stafford and Southern districts, and the remainder of the existing Midland district. Later it is intended to combine Nos. 2 and 3, and 5 and 6; so that the number of districts will be reduced to six.

At present each district is in the charge of a chief inspector and two assistants, with one electrical inspector for the whole of the districts. Under the new *régime* each district will be in charge of a divisional inspector, whose salary will be £750, rising to £1,000; and a new class of senior inspectors is created with a scale of salary rising from £500 to £700, who will act under the divisional Inspector, and be assisted by the junior class of Inspectors, whose salary is fixed at from £400 to £450.

There is no doubt that the change is an excellent one, and will facilitate the work of inspection, but we greatly regret that it has not been thought necessary to attach an electrical Inspector to each division, and we trust that the Committee now dealing with the question of electricity in mines will carefully consider the advisability of making such a recommendation to the Home Office. We believe we were the first to make the suggestion that an electrical Inspector should be appointed; and though we do not for a moment wish to put forward the claim that the appointment was made at our instigation, yet the importance of the question, and the fact that the appointment was made some little time afterwards, entitle us to ask for more than a passing notice of what we now suggest.

The colliery manager views with some distrust this question of inspection, as it is his business to get the coals out of the pit as cheaply and as quickly as possible, so as to do the best he can for his employers, and, at the same time, win laurels for himself, and he does not care to be bothered with Inspectors, who may hamper him to some extent in his operations.

All this, of course, is quite right and proper, but in carrying out this object he is inclined to economise, with the result that it is often touch and go between safety and danger to both workmen and property. This is especially the case

when dealing with electricity, as he has little or no intimate knowledge of the details of electrical engineering himself, and, as a fact, mainly depends upon the advice of outside manufacturers, who, whilst having electrical engineering experience, have too little knowledge of actual mining conditions, and who, moreover, have to trim the advice to suit the price. Or, on the other hand, he assumes sufficient knowledge, and fixes dimensions and horse-power himself, leaving the contractors to tender on the information given them, with the result that he receives a great many designs of apparatus and tenders: listens to all that the representatives have to say in support of their apparatus; prepares a schedule of prices, and accepts the lowest. He is assured that it will efficiently do the work, is perfectly safe, and strictly conforms to the mines regulations; and it is not till the plant is installed and put to work that he concludes that electricity is a nuisance and electrical engineers all a pack of fools.

We certainly have no wish to add to the difficulties or anxieties of the colliery manager, and least of all to harass him by regulations and inspection, but we have most sincerely at heart the development of electricity in our mines, and we claim that there is no other agent so useful, so safe, or so efficient when properly installed and worked as electricity; and it is our firm belief that a system of inspection such as we suggest would rather tend to develop than to hinder its more extended use. The object of all inspection is to prevent accidents, and if the appointment of an electrical inspector to each division led to the diminution of electrical accidents in mines, there would be less talk of the dangers of electricity, and a little more common sense would be exercised both in the design and selection of the apparatus and in its operation.

Should our suggestion be taken up and acted upon, we trust that the men appointed will be carefully selected, and that they will *not* be young men fresh from college, with a brand new diploma or degree and *nothing else* to recommend them; but let them be men with at least ten years' experience in the *practical application of electricity to mines*; men imbued with a certain amount of tact and common sense, and absolutely free from all the objectionable features commonly summed up in that expressive, though slangy, term, "a bounder."

Electrical Affairs in India.

In another part of this issue a letter appears from a correspondent in India regarding Government electrical contracts, and we trust that the complaint which there finds expression will receive attention in the right quarter. One of our regular contributors in India also writes to us this week in a strain which suggests that contracting firms are not always treated with fair consideration. Let us quote what he says:—

"Business generally in India this year promises to be very brisk. Government inquiries and orders are many, and a recent order of Government authorising military works and P.W.D. engineers to purchase in India where possible, has brought a ray of hope to the various engineering contractors who were heretofore overlooked or treated as a casual convenience. One great inconvenience, however, calls for comment, and this is, that rarely, if ever, is sufficient time given to get prices for quotations from home by mail. Of course, most up-to-date offices are equipped with the most recent price-lists, discounts, and full particulars regarding ordinary current material; but when tenders are required for special work, such as hydraulic machinery and long-distance transmission equipment, it is impossible to send satisfactory details home and receive quotations by cable within the time allowed. At least eight to ten weeks should be allowed between calling for tenders and the closing date for receiving them. This, although it may reduce somewhat the revenue of Reuter and the other cable company, would lead to more satisfactory results generally. The purchaser would certainly gain by having more detailed and accurate tenders submitted to him, and much after-misunderstading would be avoided. The contractor who submits tenders would, at any rate, have a better run for his trouble and expense in getting out an estimate."

The same writer also makes suggestions for greater usefulness of the I.E.E. by the formation of local sections in India. He says:—

"It is very regrettable that no attempt is made to hold meetings in the large Indian centres. There are now very many members of the Institution scattered all over India, and especially in the bigger towns, who would undoubtedly be glad of an opportunity to foregather, say once a quarter, and discuss topics of mutual interest. The last meeting was held in Calcutta in 1903, when a very interesting paper was read by Prof. Brühl, but since then no successful effort has been made to hold a meeting. Engineers are undoubtedly harder worked in India than they are at home, and have very little time for writing or discussing technical matters after business hours; but, in spite of this handicap, if a serious effort were made by some of the local enthusiastic Institution members, no doubt a response would be made, and members would turn up in sufficient numbers. An appeal from the president at headquarters to members living abroad, or an invitation to send papers home, might have the desired effect."

Copper.

Reviewing the copper output and position for the year 1909, the writer of an article in the *Times* of April 8th brings forward, first, the increase of 84,945 tons in the world's output for 1909, as compared with 1908; secondly, the ascendency of the American continents in copper producing, giving, as they did last year, 74 per cent. of the world's supply; and thirdly, the prospect of regulated, or reduced, production in the future. The aggregate world's production of copper in 1909 amounted to 839,255 tons, the increase over the preceding year being the largest in percentage since 1904, the figures being 11·2 and 12·0 per cent. respectively. 1907 showed a decrease of ·03 per cent. over 1906. In the analysis, the following decreases are noted: Australasia 5,100 tons (due to the strike in the coal-mining industry), Canada 4,465 tons, Chile 2,530 tons, Russia 2,335 tons, Spain and Portugal 400 tons, and Norway 110 tons.

The proportion of the world's total output of copper mined in the United States and Mexico, which had fallen to 61 per cent. in 1908, has risen to 65 per cent. in 1909, chiefly owing to the great rise in output in Montana and the older mines of Mexico. It would almost appear that American copper is supplying the market to such an extent as to render European mining less profitable, and to account for the decreased output.

Commenting on the combination movement, the article says:—"Messrs. J. P. Morgan and the Cole and Ryan group of financiers are understood to be the moving spirits in the negotiations now being carried on, and it is believed that they favour this form of agreement rather than the formation of a trust." The form of agreement referred to is one to regulate production. The only difficulty, we are told, which stands in the way of such an agreement is that many of the mines and smelters (notably those owned by the Amalgamated Copper Co.) cannot be operated successfully, except when worked at their maximum capacity. In spite of this, the writer anticipates that a production agreement will be effected before long, and stocks unloaded in consequence. When these are reduced, says the writer, a rise in the price of the metal may fairly be expected.

As Others See Us.

In a recent issue of this journal there appeared some notes on the new standard testing burner which the gas companies are seeking powers to bring into general use.

Our observations did not meet with the approval of a writer in the *Gas World*—in fact, they seem to have caused him some annoyance. Referring to our surmise that the use of a more efficient testing burner would result in a lowering of the illuminating value of gas, in order to cheapen production, he omits to deny the probability, but complains that the sliding scale, by which the supplier is obliged to return the bulk of any saving effected to the consumer in the form of a reduction in price, was not explained. The writer further states that "a consumer of gas may obtain from 5 to 250 candles of luminous intensity from the same *quantity* of gas which the Act of Parliament calls 16 or 14 candles." As we are unwilling to "pass over these words as having no meaning," we must fall back upon the assumption that some gas burners are 50 times more efficient than others, which opens up an interesting field for experiment by the earnest consumer.

A suggestion that it might be unwise for the gas companies to lower the quality of their products in the face of electrical competition is met by an assurance that "we need not worry, as the gas industry realises that cheapness is the key to big trade." It is true that the final cost of the light, heat or power to the user does decide the direction in which his custom will go, but that final cost is compounded of first cost and quality and efficiency of consuming apparatus.

Our observations as to the need for protecting the interests of those who are unable to bear the expense of altering their fittings to suit changes in the composition of gas, and on the importance of maintaining calorific value for the benefit of users of engines and stoves, have escaped criticism, and the writer concludes with an attack upon the system of charging different rates for different uses of the supply.

The rates charged in different places for energy used by tramways cannot be compared without a knowledge of the local conditions—the allocation of capital expenditure, and the extent to which the supply undertaking controls and maintains the engineering equipment beyond the generating station; in many instances the price of the unit covers various charges beyond generation and distribution.

The different rates in vogue for electricity used during the few hours of evening lighting and throughout the remainder of the 24 only prove that the suppliers know the exact incidence of their costs, and are working with the object of so widening the use and increasing the demand for their commodity that they may arrive at a position when they can adopt for all purposes the flat-rate system, which is used by the gas companies because their ability to hold a store of gas between their generators and their consumers has kept them free from the problems arising out of short periods of heavy, and long periods of light, demand upon the works.

The L.U.T. and Renewals.

We regret to notice that the accounts of the London United Tramways, Ltd., for the past year disclose a poor record and consequently a disappointing result, the credit balance on profit and loss account, after providing for interest on debenture stock and loans for the year and for income-tax, amounting to only £21,950. We are glad, however, that the directors have decided (though late in the day) to follow the advice which we ventured to give them when reviewing the accounts of the company on a previous occasion. They have concluded from the standpoints of economy and efficiency to pass the preference dividend, and to transfer £21,000 of the credit balance mentioned to renewals, carrying the balance of £950 forward. The course proposed is a wise one; but it would appear that its adoption has only come about by *force majeure*. The policy should have been initiated years ago, even at the expense of preference dividends, for a company with a healthy reserve, and its works in an efficient condition, though not for the moment paying dividends, is in a much better position than a company declaring so-called dividends, and more than starving itself to do so. In such circumstances such "dividends" practically amount to payments out of capital, and not out of surplus profits available for distribution. We have, upon occasions almost too numerous to mention, endeavoured to impress upon industrial undertakings the necessity and ever-growing importance of initiating and maintaining a reasonable reserve, so that renewals may be taken in hand as they are needed, and that each year's trade may bear its due proportion of the loss without disturbing the usual equilibrium of the revenue account, for depreciation is a loss, and no profit can be deemed a true one until after adequate provision has been made therefor. If the London United Co. had each year debited profit and loss account with its fair share of depreciation, which is beyond the effective power of ordinary repairs and maintenance, it is reasonable to assume that it would not have been necessary to allocate almost the whole of the credit balance of profit and loss account to depreciation, as it has been compelled to do for the year under observation.

Commercial Morality.

In our issue of March 25th we commented upon a paper entitled "Precarious Expedients in Engineering Practice," which had been read by Mr. John Hawkesworth before the American Society of Civil Engineers. The paper dealt with American practice, but some of the difficulties described as arising between engineers and contractors there, are not unknown in this country.

The first portion of the discussion upon this paper has now reached us, and it consists of the written opinions of five well-known engineers. They all concur in thanking the author for his courage in bringing the question before the association, and acknowledge the existence of far too low a standard of professional morality. Indeed, one writer goes so far as to point out how, under modern systems of education—at any rate, in the United States—"The natural result is that most young men get no moral education at all, and are thrown into business conditions which they do not fully understand, with no real conception of right and wrong."

Is it any wonder, he goes on to ask, if such a course of action results in a lax code of morality and fosters the continuance of the unworthy actions exposed in the paper?

Another writer condemns the practice of allowing young inspectors to accept or reject work, arguing that the better course is for the inspector merely to examine and test and then to report to his chief, who shall himself finally decide whether the material complies or not with the specification. This is the usual British practice, and experience proves that it is generally satisfactory to all parties.

A third writer points out the differing and competing interests which owner, engineer and contractor have under existing business conditions. They are practically at war with each other, each trying to secure as much as possible for the least outlay, often at each other's expense. He advocates, in place of the present competitive system, one in which the savings effected by good work and careful design should be shared by all, so that it would be to the interest of all that the best, and only the best, work should be done. He acknowledges that these ideas are to a large extent Utopian, but perhaps they bear in them the cure for many of the evils he deplores. The remaining critics deal more particularly with cases of collusion between engineers and contractors which resulted in flagrant wrongs being done to the owners.

All point to the fact that, to-day more than ever, character is the real test of reputation, and that without integrity and right principle even ability will not lead to lasting success. This is true, not only in the United States, but in other countries as well, and the lesson may well be learned by our younger men here.

D

ELECTRICITY IN MINING.

By J. GLYNN WILLIAMS.

In coal mining we have innumerable difficulties and conditions to contend with, whereas in iron ore and lead mining the chief difficulty is water. In gold, silver and diamond mining the conditions for working are comparatively simple, and if coal mining is dealt with it will practically cover all other sections of mining work, and at the same time give plenty of matter for discussion.

The prejudice against the use of electricity generally seems to have existed ever since it was first used. Naturally, the question is asked WHY? In the writer's opinion the best explanation is "because it is an *invisible* force." Other forms of mechanical power may be looked upon as having some outward visible sign, and may be detected by the senses, but in the case of electricity we have to rely more or less on scientific instruments to show us that a leakage is occurring.

It is, therefore, this seemingly unnatural condition that the ordinary human mind does not easily conform to, and it therefore tends to create a feeling of fear against a force which is unseen and apparently incomprehensible.

Is not this the reason why so many accidents, fires, &c., the causes of which cannot be traced, are immediately put down if at all possible to electricity, especially if electrical power is used anywhere in the vicinity? And is not this, to a great extent, helped by the daily Press, who seem to jump to the same conclusion, as is evidenced by their reports from time to time? Even the technical Press are to be censured for not giving more technical details in reports of accidents attributed to electrical causes. Further, if the coroners' juries in these cases were composed of technical men we should be much more satisfied with their decisions, and it would undoubtedly eliminate the prejudice which has existed always and still exists.

To sum up, therefore, we may look upon electricity and its applications as a partly scientific question, to be dealt with in its various aspects by men trained technically and practically. That is the first essential; the second is the use of good materials. There is no doubt, of course, that there are risks attendant upon the use or misuse of electricity. It is imperative that these risks should be safeguarded. With the instruments at our command at the present day we can immediately record any leakage, and so take steps to find it and remedy it; or to go even further, we have means in our power automatically to cut off the faulty section immediately a fault appears and remedy it afterwards.

Before giving an opinion as to the best way to electrically equip a colliery, it will be well to give some actual experiences of the conditions existent at the present time. We will first of all take the section referring to men in charge, who, according to the rules, are termed "competent." What is the use of the Home Office issuing rules unless it sees that they are adhered to? During nearly four years past I have only been questioned on electrical work or matters by mines inspectors on two occasions. In one case I was simply asked where I kept my rubber gloves, and how many sand buckets there were in each motor house; and on the other occasion, the only question asked was if there were any insulating mats for motor men to stand on.

No technical questions were put to me, nor do I know of any other person in charge of a colliery electrical plant being questioned as to his competency by a mines inspector; yet in such a simple matter as men joining the Army in the Engineers, I have had several men sent to me to be examined as to their practical qualifications before being accepted, and when they are enlisted, what are their responsibilities compared to those who are practically responsible for the lives of hundreds of men? A plumber who can fix electric bells, or put a lamp in a holder, a man who has been a labourer in the works of an electrical manufacturing firm, or a man who has been, say, a wireman's mate—each calls himself an electrician. Any of these men would have the audacity to apply for a job as electrician to take charge of a colliery plant, and I can prove actual cases of their having done so, and even having obtained the job. This state of affairs is also encouraged by the electrical contractor, who installs a plant, and tells the management that it does not require a skilled electrician to look after it, and he is assisted in this theory or argument even by insurance companies who insure plants against breakdown, &c. Would it not be better for the insurance companies who take these risks to satisfy themselves as to the competency of the men in charge, for their own benefit, and to charge lower premiums and keep business, instead of losing it altogether, as I know they have done?

I will admit that perhaps the travellers connected with electrical contractors, &c., have used the argument that the plant will run itself, so as to get the business, but if the principals of such firms were to pay a visit to the plants installed, say, one or two years later, they would in a good many cases hear some very interesting facts, and they would also understand why they did not receive further orders, and this same remark also applies to a good many electrical manufacturers.

Their reputations are undoubtedly dependent upon those who have to take charge of the running of their plants, and it is, therefore, to their interest to secure as far as lies in their power that such persons are not only *termed* competent, but *are* skilled competents.

Colliery managers are certainly becoming more alive in the selection of electricians, but at the same time it should be the duty of the Home Office to satisfy itself that electricians in charge are skilled men, and are proved competent by proper examination.

I send for your inspection a sample of work done by a so-called competent man who was in charge of a colliery plant for 18 months, and who was found out when a breakdown occurred. The breakdown was the burning-out of a 50-H.P. induction motor stator winding, caused by a bearing getting hot and seizing. The so-called "electrician" endeavoured to make the rotor revolve by putting in heavier fuses and telling the generator attendant to hold the main switch in, to prevent its release on overload.

This burnt out a stator coil, which the electrician tried to rewind himself, but as he could not do it the motor was sent to the manufacturers, who charged £60 for the repairs. This charge being excessive, the manufacturers closed the door on themselves for further business, although the machines turned out by them were very satisfactory.

It is without doubt a great responsibility on the part of those in authority to put a man in charge of a colliery electrical plant, when the dangerous conditions under which the plant must work are considered, and that the lives of men are dependent on its efficient working. The average person has no idea of the extraordinary risks undertaken by those engaged in winning coal from the bowels of the earth. In railway work we know that every loco. driver is fully trained to his work before being allowed to take the responsibility of driving a passenger train, and must understand all the technicalities of his engine. In electric tramway work even, every driver has to undergo a certain period of practical instruction before being considered skilled enough to drive a car. A marine engineer must be skilled and, further, must hold a B. of T. certificate as to his competency.

A colliery winding engineman must also be skilled in his work, and in the majority of cases has had to undergo a practical training, from firing boilers to taking control of all classes of engines connected with colliery work, before being allowed to handle the levers of a winding engine.

Yet, in spite of all these comparisons, what do we find even at the present day?—One electrician only in charge of a plant running 24 hours a day. Unskilled so-called electricians in charge of plant. Motors underground worked by boys 16 to 18 years of age, and crippled colliers, &c. (compensation men) without any practical training whatever, who cannot even replace a fuse when provided with spare ones. Even in case of breakdown, they cannot explain to the person in charge what is wrong or what materials to bring in that would be likely to be useful, so as to save time and unnecessary journeys. "Motor's giv up," is all they can say.

Of course, a little knowledge is dangerous, but an elementary practical knowledge on the part of those working motors, &c., is worth pounds to the electrician-in-charge and to the management in many ways.

We will now pass on to the question of materials and apparatus. I may suggest that electrical manufacturers

and contractors undertaking mining work would find it greatly to their advantage in many ways to retain on their staff a mining electrical expert, who could advise their customers as to the best apparatus to use consistent with the conditions of the mine underground.

This would create more confidence among customers and prospective customers, and such a feeling of confidence is wanted at present; it is deplorable to see some of the apparatus in use in some mines, as well as good apparatus being used under conditions totally unsuited for it.

This state of affairs is in a good many cases unknown to the manufacturers themselves, and I am pleased to say that in several instances they have gone to considerable trouble and expense to rectify it when I have pointed it out to them.

Coming now to the question of future plants, we are faced with the problem of the system to advise—whether to advocate three-phase alternating current or direct current. There is a great diversity of opinion on this matter, and, to my mind, this question can be settled best by considering the working conditions when the plant is running. Some collieries run their main electrical plant only during the time they are drawing coal, and for lighting, signals, &c., use a smaller dynamo.

Other collieries run their electrical plant continuously day and night, it being essential that they should do so for pumping, ventilation, coal-cutting, &c., or for transmission to other pits.

Where direct current is employed, storage batteries can be used to great advantage in reducing working costs, and provide a standby in case of breakdown. This question is dealt with fully by the writer in a paper read by him before the Cumberland branch of the Institution of Mining Electrical Engineers, April 16th, 1910. Until such time arrives that manufacturers can turn out D.C. machines to run quite sparklessly under varying loads, and so be safe under certain conditions of working underground, would it not be an easy matter, where the main generated current is direct, to transform it to A.C. three-phase for use underground where General Rule 8 applies?

Coming to the cable section, this is a point on which no hard-and-fast rule can be laid down, and which must be left to the discretion of the mining expert attached to the cable company's staff.

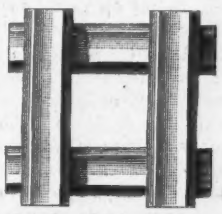
The conditions underground vary so much in the conditions as to temperature, humidity, risks of falls, &c., that various classes of insulation for cables have each their disadvantages and advantages; but from personal experience, and in view of the use of oil-immersed apparatus, the best cable I find for general work is paper-insulated lead-covered, with a double layer of jute yarn well compounded; if steel or wire-armoured cables are used for shaft work they should also be lead-covered, so as to have a continuity of lead-covering from end to end of the cables for efficient earthing. Joints in-bye in places to which General Rule 8 applies are best made in boxes with terminals and connecting links immersed in oil, and in cases of abrasion of lead covering, through falls, &c., the damaged portion should be covered with lead strip tape, afterwards covered with ordinary tape well soaked in paraffin wax, which can be warmed by the heat of a safety lamp, and, lastly, covered with a double layer of prepared bitumen tape. This will exclude any moisture, &c., from attacking the oiled paper insulation on the conductors, and also prevents the oil in the paper from leaking or oozing out of the abrasion.

For three-phase work I am inclined to the use of three-core cables in preference to concentric, and for D.C. work single conductors, run on different sides of the level or main road.

Shaft cables, which should always be run down the downcast or intake air shaft, should be bitumen insulated and lead-covered, with two layers of wire armouring and a double layer of jute yarn well compounded. This class of cable has been found to be most serviceable under differences of temperature, water, &c., and should be supported by clamps 4 ft. long at intervals of not more than 15 yds.; the clamps to be of hard wood, well creosoted and with chamfered tops.

As to motors generally, one great difficulty the mining man has to contend with is dust getting into the windings. Take a three-phase motor, would it not be possible for the ends of the stator windings to be covered with sheet-iron stampings? This would not interfere with the efficiency of the machine, but would be advantageous in excluding dust, and at the same time prevent the liability of oil from the bearings getting into the stator coils. The windings at the ends of wire-wound rotors could also be enclosed in a similar manner. This is an idea which I think is an original one, and which, as a mining man, I would like to see tried.

The rotor connections to slip-rings should not be made too rigid, owing to their liability to fracture under vibration, more especially in cases where it is not always possible to get a good foundation, such as a motor pump following a heading, &c. Speaking of foundations for motors generally, the following sketch shows one which I have found very efficacious, consisting of four 9 in. × 3 in. timbers, with chamfered edges, two laid across two thus, and filled up level to top timbers with cement or concrete filling. Motors can then be secured to the timbers with coach screws, and will run without any vibration and at the same time be on a good foundation, which is the quickest and easiest to make, and cheap. In the case of D.C. motors it is usual to use shunt machines for endless haulage, and have a friction clutch operating on the drum, but in general use the motor attendant starts and stops the motor with his controller and ignores the friction clutch altogether, and for this reason chiefly the compound-wound motor is to be preferred generally.



Motor Foundation.

It is rather singular that for tail ropes, such as brew or dilly winding, the drums in the United Kingdom, as a rule, have no indicator to show the position of the end of the rope, and it is considered superfluous, although the motor man cannot see out of the engine or motor house; yet nearly all similar plants going to South Africa have to be provided with tell-tale indicators, and the motor man has not to rely upon his signal bell only.

As it is sometimes the practice to allow men to travel in tubs up and down brews, it is just as essential to have an indicator in use as on a winding engine for shaft winding, and all motors for this work should be fitted with magnetic brakes.

Fuses in colliery work should be eliminated altogether. It is quite possible to run a plant without the dangers attendant upon their use, by using oil-immersed circuit breakers. In using fuses, there is always a tendency to allow a larger margin than is necessary, to avoid continually renewing them, especially on haulage and coal-cutter work, and with the perfection now arrived at in circuit-breakers, there is every likelihood of the future colliery plants being equipped throughout with them when the advantages of their use are more fully understood.

Many accidents, breakdowns, and stoppages would be prevented by their use, and the extra cost incurred in installing them would be more than reimbursed by the saving in time and cost of repairs, without even taking into consideration the safety factor, which is most important.

It is quite a common thing for those attending pump motors on night shift to go to sleep, or even to run them without attendance, and only recently I had an experience which in some pits, or parts of a pit, would have been absolutely dangerous.

A motor driving a centrifugal pump was running unattended. During this time it was necessary to change over generators, and in this operation the circuit was broken and made again; the generator attendant, apparently, did not do this quickly, and, owing to the period of time which elapsed between break and make, it caused a fuse to blow on one phase at the motor pump underground. The current, there-

fore, being on two phases, caused the leads to heat up, melted the solder in the terminals, and set fire to the insulation, braiding, &c. The colliers passing by, going in-bye to work, were afraid, naturally, to proceed until some one came up who had the presence of mind to open the switch. Had this happened in a fiery part of the pit the consequences would be awful to contemplate, and had a circuit-breaker been in use such an occurrence would not have taken place.

The two remaining fuses were not above the normal size, and the heating and burning of insulation of cables occurred between the slip-ring brushes and the starting box.

I would also advocate the use of starting boxes with interlocking gear, so that it is impossible to put the circuit supply switch in to excite the stator unless the starting or short-circuiting switch for the rotor is entirely off.

In taking controllers as the next item, the most perfect one for mining work, in my opinion, is the special mining oil-immersed controller made by the British Westinghouse Co., Trafford Park. Its advantages are numerous. First of all, the contacts are oil-immersed and easy of replacement; the box cannot be opened whilst current is on; the insulation of leads is not liable to deterioration with oil creeping, as the connecting terminals are brought outside the oil case and enclosed in a gas-tight cover on the side of the controller case. The whole thing is exceptionally strong, and will stand very rough treatment without injury to the working parts.

All new mining installations (electrical) should be examined and passed as satisfactory by an expert appointed by the Home Office before being allowed to work.

The Institution of Mining Electrical Engineers will deal with the question of efficiency in workmanship by its diploma-ship, when it has been accepted as a recognised body and incorporated by the Board of Trade, and by the experience and opinions of its members, manufacturers will be put in a better position to know the various requirements and conditions obtaining in coal-mining work. We can then hope to establish a feeling of confidence and security in the minds of those who come in contact with, and are directly concerned in, the use and applications of electricity in mining.

THE INSTALLATION AND MANAGEMENT OF ELECTRICAL PLANT IN COAL MINES.

By T. CAMPBELL FUTERS, M.I.M.E.

It seems superfluous to say that a coal mine is intended for the profitable production of coal; but judging from the amount of discussion and competition on the part of manufacturers, one might be excused for thinking that a colliery was a place purposely established for the installation of electrical plant, instead of the electrical plant being used as an aid for getting the coal. Hence it may be of advantage to consider the relation of electricity to coal mining from a commercial point of view, as frequently the view of the electrical engineer is widely divergent from that of the mining engineer.

The problem the mining engineer has to tackle in exploiting a new coalfield is how best to get the coal lying deep down below and raise it to the surface. He commences by sinking a shaft—or rather shafts, as at least two must be sunk—often overcoming immense difficulties, and at great expense. When the coal is reached, he burrows into the seam in all directions, conveys it to the bottom of the shafts, and hauls it up to the surface. Now, there are some people who would have us believe that the first thing the mining engineer ought to do is to buy a set of steam boilers and a generating set, place these in the middle of the field where the shafts are to be sunk, and commence at once to generate electricity, and do everything else with the aid of this electricity. That it can be done, there is no question, and the young engineer full of *technique* and a firm belief in being up to date, but with little experience on the commercial side of the question, may even be inclined to suggest doing it; but from the standpoint of the man who has to pay, the question is, Would it be a wise thing to do? To answer the question we may consider what has to be done during the operation of sinking, keeping in view the fact that it is desirable to put down only such plant as may be utilised afterwards. First there is the *débris* to be lifted out of the shaft by a winding engine; secondly, there may be a large quantity of water to pump; thirdly, a small fan may be required for ventilation; and fourthly, there may be drilling machinery to operate for boring shot holes.

With regard to the first, it is often a difficult question to decide whether it is not better to put down the main winding engine at once and do all the sinking with it. But this involves the decision at the outset as to whether the winding is to be done by steam or electricity. If the latter, then the generating station must first be put down, and, in consequence, a large expenditure of capital incurred, which may not yield any return for a year or two, or even more, as a large colliery can seldom be put down and attain its maximum output under a period of about five years. Further than this, there is always a risk that the mine may not turn out as profitable as anticipated, though in most cases this may be remote. Again, there is the much-debated question, Does electric winding pay? There is, however, one thing certain, *i.e.*, if it is decided to put down the main winding engine to do the sinking, there would be a greater loss with the electrical equipment than with a steam engine, as with the latter the interest on capital cost and the running costs of the generating plant would be saved, and probably most winding engineers would infinitely prefer a steam engine to an electrical engine for sinking purposes. If it is decided that the main winding is to be done by steam, then the engine may be put down at once, with sufficient boilers to supply it, which would save the cost of a temporary engine, but in any case under ordinary conditions it is difficult to see how any useful purpose could be served by putting down an electrically-driven temporary engine. The equipment would cost more, there would be no compensating advantages, and it is very questionable whether it would give such good results.

The second point, that of pumping, is not so easily disposed of, and it very greatly depends upon the quantity of water to be dealt with. Latterly, high-speed motor-driven centrifugal pumps have been adopted for sinking pits, some with good, others with very bad results. The main advantage of this type of pump is that it may be quickly raised and lowered in the shaft, by means of a rope and blocks on which both it and the rising-main pipes are suspended, and it has the further advantage over the suspended steam pump, that no steam pipes are required, and the—often enormous—condensation losses are saved. Each pump is self-contained, and it has the advantage over the old type wet spear pump, in that no fastenings or buntons are required in the shaft. Great difficulty, however, has been found in some cases, owing to the enormous wear and tear, especially where the water is gritty. Otherwise it is an excellent type of pump, but it ought to be very carefully designed with a full knowledge of the duty it has to perform; and the *speed* should be kept as *low as possible* if the water is of a gritty nature. In connection with these pumps there will be required the necessary crab winches, which are eminently suitable for an electric drive. To work these pumps, it is, of course, necessary to put down a generating plant, which, however, would also drive the small ventilating fan, and we may at once dispose of our third point, as probably no other machine is so well adapted for electric driving as a fan.

The fourth item, that of drilling machinery, is another difficult question to decide, though it is, of course, not nearly so important as winding. Unfortunately, there is no electric drill upon the market that can compete with the compressed-air percussive drill; and for shaft sinking it is practically necessary to put down an air compressor, if merely to work the drills alone. Undoubtedly, the best machine is the compressed-air hammer drill, and the question to be decided is, Shall the compressor be steam or electrically-driven?

To deal with the compressor we must consider how far compressed air is likely to be used for the transmission of power for the purposes of haulage, pumping, or coal-cutting, after the shafts are sunk. We must remember that our aim is as far as possible to put down new plant

which will be required permanently, and thus avoid unnecessary expenditure over plant which can only be of a temporary nature. So far as transmission of power is concerned, there is now no question that electricity is very much more economical as well as more flexible than air, and there is only the question of the danger attached to electricity which can possibly influence any mining engineer in installing compressed air in preference to electricity.

Leaving for a moment this question of danger, we find that both for underground pumping and haulage, electricity is very much more suitable than compressed air; and the only doubtful point to be decided is that of coal cutting. Now, as regards danger, there can be no doubt that there is a greater risk of danger with electrically-driven coal cutters than with those driven by compressed air, but in regard to the cost of power there is no question that electricity is the cheaper. Safety, however, is the chief point to be considered, and a mining engineer is justified in installing compressed-air coal cutters at their slightly higher cost of operation, if by so doing he is minimising risks of breakdowns and accidents to the workmen. In such a case the difference in cost is to be looked upon as an insurance premium against accidents, and frequently it is worth it. Owing to the severe conditions of coal cutting, and the fact that the machine is portable instead of stationary, involving the use of trailing cables and more or less temporary connections, and the very unfavourable atmospheric conditions, the mine manager has every reason to hesitate before adopting electric coal cutters.

Assuming, however, compressed-air machines are adopted, the air compressor may often with advantage be electrically driven, and in any case as the proportion of actual power required for coal cutting will be small compared to that required for haulage and pumping, its influence upon the load curve of the generators may be more helpful than otherwise. Further, an electrically-driven air compressor has the advantage that it can be placed below ground, so that provided the first cost is about the same, the advantage would seem to lie with the electrically-driven machine, but the matter can only be decided by a very careful consideration of the circumstances.

We have thus two out of the four important operations of sinking a new pit, particularly suitable for electric driving; there is also that of lighting, which is now nearly always electric, even when this involves the putting down of a small lighting set.

As regards the other two, electricity is not so suitable for the first, and is of doubtful utility in the fourth, and for both operations it would in all probability pay to put down temporary steam engines in preference to electrically-driven machines. Even with the second operation—that of pumping—it must not be assumed that the electric turbine pump is the *summum bonum* in a sinking pit. Very much may be said for the old wet spear pump, especially if the quantity of water to be dealt with is great, and is of a gritty nature. The actual cost of keeping the water down is nothing compared to the certainty of the operation being efficiently performed, and there should always be a large margin in capacity.

We may now turn our attention to the generating station, and the first point to be decided is the type of steam generator to adopt. Here we must remember that we are dealing with the permanent plant, and that in all probability most of the auxiliary machinery on the surface and underground will depend upon it. Further, it must be economical; and it is not so much now a question of first cost as one of reliability and low running costs. Another point to be decided is whether to install alternating or direct current, but in view of the almost universal adoption of three-phase plant, it is easy to decide this question in favour of the former, though direct-current plant has many points to recommend it for certain operations.

In regard to the type of steam generator, the tendency at present is to install exhaust or mixed steam turbo-generators. The great advantage of this type is that it allows the mining engineer to adopt steam plant where this can be most effectively used, and the exhaust steam instead of being wasted is returned to the exhaust steam turbine, and used to generate current. In designing a generating station, therefore, it is well to consider that with the development of the colliery the demands upon the station will grow, and provision should be made for its extension. Further, it is important to carefully consider the size of each unit. If large they will be more efficient at full load, but it is very unlikely that at a colliery full load can be maintained for 24 hours; if, however, they are small, the capital cost is relatively higher, though they are convenient to start up or shut down as the load varies. Probably the better plan is to install a medium size generator of the mixed-flow type, using all the exhaust steam from the temporary winding and other engines during sinking, and to couple this up to the main steam winding engine after the pits are completed. This set should be duplicated later on, and additional live steam sets gradually installed as the load grows; but in all cases a margin of at least *one* machine should be allowed. The first machine installed will be large enough to drive all the auxiliary plant in connection with sinking operations. This is very much better than installing a large generator at the outset, involving a large expenditure of capital which could not yield any return for some years. Further, after the machine is working up to its maximum load, a breakdown would mean a very serious loss; hence it is better to divide the plant into units of reasonable dimensions, with one spare, ready to be put into commission in case of emergency.

Once the shafts are sunk, and a commencement is made to draw coals, there will be the operation of haulage and pumping, underground, and on the surface the ventilating fan, screening plant, workshops, hoists, &c., all of which can be most efficiently worked by electricity transmitted from the central generating station. This brings us to the question of the pressure of transmission, and whilst experience has proved beyond question that, for constantly running stationary motors, such as for driving ventilating fans, pumps, &c., there is no difficulty with pressures up to 5,000 volts, yet, where motors are to be operated by workmen, it would appear to be much safer to reduce this pressure to 200 volts, or even below, by means of transformers contained in well-ventilated brick chambers, with locked iron doors, into which no one can possibly enter, except the electrician-in-charge; and even then it ought not to be possible to enter until the current is switched off.

For lighting, the voltage should never exceed 110 volts, and the lower the better. With lower voltages the risk of breakdown and accident is minimised, and although the cost of low-voltage machines may be a little higher, the extra cost will be justified in lessened risk of damage, and what is very much worse than damage to the machine itself, of "stopping work."

In putting down electrical plant, it is well to standardise as many machines as possible, together with the controlling apparatus, and in all cases to keep to the *simplest arrangement that it is possible to obtain*. Avoid as far as possible all complicated "fool-proof" "cannot-possibly-go-wrong" types of apparatus; they do not tend to the exercise of ordinary intelligence on the part of the workman, whose business it is to work the apparatus, and he is imbued with a false sense of security, and non-responsibility. A great mistake in the past in connection with the application of electricity to mines, has been that when an accident has occurred, instead of trying to educate the operator to a sense of his responsibility, an attempt has been made by the addition of locks, bolts, catches, and trips, to make the apparatus such that the man could not do wrong again. Further, if the voltage on all the working parts of the machines is low, there is not the same danger of shock or breakdown, and it will be much easier to maintain the insulation of the system.

As regards the *personnel* required in the management of the plant, the very worst economy is to cheesepare by employing cheap men. The manager, of course, is legally responsible, and is entitled to appoint anyone whom he considers a competent person. Frequently, however, there is a chief mechanical engineer with a colliery training (and quite properly the electrical plant and the electricians would come under him), who should be directly responsible to both the law and the owners. On the other hand, there is the question of dual responsibility, but this is a matter which would no doubt adjust itself if the Home Office decided to grant certificates of competency to mechanical engineers. The

Commission at present sitting to inquire into the rules regulating electricity in mines will in all probability take this matter into consideration. Such certificates would certainly be greatly to the mutual advantage of both employer and employé at individual collieries, as well as the electrical and mining engineering industries.

THE SUPPLY OF ELECTRICITY BY PRIVATE PERSONS.

[FROM A LEGAL CONTRIBUTOR.]

From time to time queries are published in these columns relating to the supply of electricity by persons who do not work in accordance with the terms of a provisional order. Prior to April 1st in this year, the law gave no direct power to authorised undertakers to interfere with, or prevent the private supply of, electricity in their district. No such restriction was to be found in the Electric Lighting Acts. The Act of 1882 made no provision for regulating the supply of electricity otherwise than under a provisional order or a special Act. Thus, after that Act was passed, whereas persons who supplied electricity under a provisional order were subject to elaborate rules made by the Board of Trade in carrying out the details of their undertaking, the owners of an installation who furnished their neighbours with a private supply were under no restrictions whatever. For instance, by regulations made under the Act of 1882, the use of aerial lines was very much restricted ; but these rules only applied to statutory undertakers.

The law is quite different now owing to the Electric Lighting Act, 1909, which came into force on April 1st, 1910, and the more general provisions of which have already been alluded to in these columns. In future, the private supply of electricity in an area where there is a provisional order in force is to be absolutely prohibited—except in certain special cases to be presently mentioned. Of course, the prohibition does not affect any area where there is no provisional order in force. In such places, private supply may go on as before.

The other exceptions to the generality of the rule are of considerable importance. In the first place, it merely prevents anyone from *commencing* to supply electricity in a prohibited area after April 1st, 1910. It is presumed that, if there was a business of supply in existence on that day, it may continue to be carried on. Further, in the case of a district where there is now no provisional order, the fact that a provisional order is hereafter obtained to allow a supply to be given in that area, will not enable the company or local authority obtaining the order to secure the closing down of all the private installations in the district.

Again, the prohibition does not apply to a man who makes no business of supplying electricity, but who happens to have an installation, and who allows his neighbour to have a supply. Whether a man is making a business of this kind must, of course, be decided as a question of fact, and will probably come before the Courts before long. Again, the question is sure to arise whether the charging of accumulators constitutes a supply within the meaning of the Act.

We have now said enough to show that, although the private supply of electricity will in future be limited, it will continue to exist; and it is, therefore, still necessary to follow the rules and regulations under which such a business of supply is to be carried on.

It was in order to bring private supply companies and persons supplying electricity privately under the jurisdiction of the Board of Trade that a special clause was inserted in the Electric Lighting Act of 1888. By Sec. 4 of that Act it is provided that where in any case any electric line or other work may have been laid down or erected in, over, along, across or under, any street for the purpose of supplying electricity, or may have been laid down or erected in any other position for such purpose, in such a manner as not to be entirely enclosed with any building or buildings, or where any electric line or work so laid down or erected may be used for such purpose otherwise than under and subject to the provisions of a licence or provisional order, the Board of Trade may, by notice served upon the body owning or using the line, require that such line shall be continued and used only in accordance with the conditions and rules which they may prescribe.

A proviso excepts from the operation of that section "every electric" line or work laid down or erected by any body or person for the supply of electricity generated upon any premises occupied by such body or person to any other part of such premises.

Any person failing to observe the Regulations and Orders of the Board of Trade is subject to penalties. The Board of Trade have issued Regulations drafted to meet the requirements of this section, the general effect of which is similar to those which have to be observed by companies and local authorities which supply electricity under statutory powers. To deal with them at length would be beyond the scope of the present article. It may be pointed out, however, that Regulation 2 prohibits earth connection except in the manner there provided. Regulation 4 limits the pressure between any two conductors or between any part of either conductor and the earth to 3,000 volts. Regulation 14 substitutes 100,000 watts for the 300,000 in the ordinary regulations as the limit which a high-pressure electric line may be used for transmitting. Regulation 17 provides precautions against injurious effects due to induction, while Regulation 18 contains special provisions for the protection of the Postmaster-General.

It should be observed, however, that compliance with the Board of Trade Regulations does not always completely protect a man who supplies electricity in the manner above described. He may have to observe certain by-laws issued by the local authority of the district in which his works are situated.

If a person supplying electricity without a provisional order desires to extend his operations further afield, considerations arise which must be duly observed. Thus he may find it necessary to place his mains under or across a highway ; and it is obvious that the highway authority must, as a rule, be consulted, either when the surface of the road is to be torn up or when wires are to be suspended above it. In some cases the local authority own the freehold of the road, in which case they are entitled to everything which is below and above the surface of the street. In other cases, their authority extends merely to the surface ; and so long as the surface and the free passage of the public to and fro are not interfered with, the landowners on either side, in whom the freehold of the road is vested, can authorise the suspension of wires over the road at any height they choose, so long as the wires are sufficiently high to be out of the reach of passing traffic.

In urban districts the local authority by adopting Part II of the Public Health Acts Amendment Act, 1890 (53 and 54 Vict. c. 59) may acquire power to make by-laws for the prevention of danger or obstruction to the public from posts, wires, tubes, or any other apparatus stretched or placed above, over, along, or across any street (whether before or after the adoption of that part of the Act) for the purpose of any telegraph, telephone, lighting, railway signalling or other purpose. Again, in the case of London, overhead wires can only be erected in accordance with by-laws made under the London Overhead Wires Act, 1891.

Summary of the Law.—Having drawn attention to the fact that the regulations made by the Board of Trade and the local by-laws must be observed by those who undertake the private supply of electricity, we have enumerated all the matters to which the attention of a person who desires to supply electricity should be directed. In other respects he is upon the footing of a trader in any commodity. He can make what contracts he likes with his consumer, he can grant a supply at whatever price he thinks proper. Moreover, his operations cannot be interfered with by any local authority or company, unless such body has statutory powers to supply electricity within the district.

Japan.—According to the annual report of the Yokohama Foreign Board of Trade, the imports of insulated electric wire into the Japanese port during the past year attained a value of only £88,575, as contrasted with £106,462 in 1908.

CORRESPONDENCE.

Letters received by us after 5 P.M. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

The Imperial College of Science.

In appointing Surgeon-General Sir Alfred Keogh, K.C.B., to be Rector of the Imperial College of Technology, the Governors have made a blunder which places in the shade all their previous mistakes. The Imperial College was started with the idea of being to us what the Charlottenburg Technical University is to Germany. It was to be technological rather than purely scientific, with the idea of helping this country to keep her place in the industrial race. Such being the case, the Rector should have been chosen from amongst the many scientifically trained engineers who have made reputations in technological training and organisation.

Sir Alfred Keogh is an army man, and therefore quite out of touch with industrial affairs; and his connection with technology is only of the remote nature required of one who has held the positions of chemical assistant at the Royal Westminster Ophthalmic Hospital and surgeon at the Royal Arsenal.

Technical education is a complex problem which is ever changing, and the head of what should be the leading technical institution in the world should be an expert who, by years of actual experience, had gained an intimate knowledge of the work. Surely there are many heads of technical institutions in this country to choose from—men who have grown up in the business, as it were, and know their job from A to Z.

The new Rector may be genial, tactful, a disciplinarian and an expert medical man, but these qualifications do not in any way fit him for the position. The whole thing has a Gilbertian flavour, and if Sir Alfred Keogh is so unwise as to keep the position, he will seriously handicap the college and higher industrial progress.

This matter again shows the absolute necessity for the engineering profession to be more organised, as the medical men and the lawyers are. One can imagine the howl if an engineer had been appointed head of an institution where medical science or law was the principal study—yet here we have a medical man appointed head of what is practically an engineering college!

E. Kilburn Scott.

Bromley, Kent, *April 18th*, 1910.

Electric Smelting Furnace.

There is a misprint under "Continental Notes, Sweden," in your last issue. The name of the company erecting the electric smelting furnace is the Stora Kopparbergs Bergslags A.B., and the type of furnace which they are erecting is the Grönwall furnace, not the Gröndal, as stated in your note. Perhaps you will be good enough to correct this, as some confusion exists in many people's minds as to the distinction between the two names. They are, however, in no way connected with each other, and the two types of furnace differ fundamentally.

Jens Orten-Boving & Co.

London, E.C., *April 16th*, 1910.

Sale of Scrap Metal.

The reply to "Interested" is, that the receipts from the sale of scrap metal under the circumstances described should be allocated to "Stores," and not to either revenue or capital accounts.

This stores credit will balance the individual items on the other side entered up from the various credit notes at the times when the scrap came into store, each of which entries is a credit to the appropriate expense account, and affords the allocation required.

If the undertaking has separate banking accounts for revenue and capital, the amount should be paid into the revenue account, as that account can be operated upon in favour of capital reserve, renewals, and repayment of loans, which cannot conveniently be done to the capital account.

Henry M. Sayers.

London, S.W., *April 16th*, 1910.

Contracts in India.

As an electrical engineer resident in the city of Bombay, I have noted with interest, on page 910 of March 11th issue of the *Electrician*, that Messrs. Greaves, Cotton & Co., of this city, have received contracts for the Cama and Allbless Hospitals, Bombay, and also an order from the Bombay Government amounting to about Rs. 100,000. Probably it will be of interest to you and your readers to know that the Cama and Allbless Hospitals are also under the Government, and that none of these contracts were put up for tender.

I think this kind of thing would not be tolerated for one moment at home, and I am sure that any self-respecting Government or public body would never dream of handing over large contracts of this sort without first calling for public tenders.

Of course, I am fully aware that there are many of these contracts for which tenders are invited, but it is simply a matter of form, as it is fairly well known beforehand who the particular party is who will receive the order; still, these formulas must be gone through for appearances' sake; but, for barefaced flouting of public interests, this announcement beats anything that I know.

I am also personally aware that there were two or three other contracts given to the same firm, and it seems a most strange thing that the three or four leading electrical engineering firms in Bombay had not even an inkling that this matter was coming forward until the order was given.

I should thank you to give this matter prominence in your paper, and probably some of the powers that be at home might take the matter up, and give us all the chance to make a bid. There is not the slightest doubt that the Government will get much better value for their money if they will only go the proper way about it and call for public tenders; and when calling for tenders it will be necessary to give the tenderers ample time to go into details, and not, as is the usual practice at present, to draw up all figures in consultation with interested parties beforehand, and then call for public tenders for contracts amounting to one or two lacs, to be submitted within a day or two.

One Interested.

Bombay, *April 1st*, 1910.

Ringing Bells Automatically.

I trust this inquiry will elicit the information desired, and that your correspondents will distinguish between ringing a bell in full swing and tolling or striking. The latter is quite a simple matter, and has been accomplished by the Synchronome Co., of 32 and 34, Clerkenwell Road, London, E.C., on large church bells as well as on a smaller scale.

For striking the hour, all that is wanted is a rotary motor with worm reduction gear and a cam to depress the hammer tail. This is controlled by a little commutator with segments of lengths varying from 1 to 12, as the electrical equivalent to the dividing plate of an ordinary mechanical striking clock. Where quarter-chiming or carillons are concerned, a drum is necessary, like that of a musical box, but on a larger scale, and the motor may be geared to it direct. But if your correspondent is really a campanologist, as implied by his *nom de plume*, he will be satisfied with nothing short of ringing his bell in full swing, for, as Lord Grimthorpe says in his book on the subject, "the strike of a clock hammer, or of any other chiming machinery, is a melancholy substitute for a set of ringers, only justifiable as a precaution against strikes—of the men, I mean," and I hope to see in your columns that somebody can give it him.

F. Hope-Jones.

London, E.C., *April 18th*, 1910.

If your correspondent "Camp" will kindly communicate with us we shall be pleased to give him the information he requires. We are manufacturers of several systems for automatically ringing bells by means of a motor.

Adnil Electric Co., Ltd.
S. G. Leach, *Manager.*

London, E.C., *April 18th*, 1910.

[As we go to press, Messrs. Gent & Co., Ltd., London, E.C., write us to the same effect.—Eds. E.R.]

Protection and the Electrical Industry.

Though rather late in the day, I shall be obliged if you will kindly find space for a few remarks in reply to the letters of Mr. Glendenning and "H. S. H.," which appeared in your issue of the 4th ult., and which pressure of business has prevented my referring to earlier.

Mr. Glendenning's first paragraph is unintelligible to me. As to my having "discovered that some manufactured goods do get into Protected countries," there is nothing in my letter to suggest that I have ever been in doubt about it. It is the Tariff Reformers who complain that they do not—at any rate, not in sufficient quantity—*e.g.*, Mr. Balfour said (and quite erroneously), "Bradford goods do not now go to the States." I also quite fail to see how my "discovery" lets down some of your other correspondents.

Of the £150,000,000 of imported manufactured goods, a very large proportion is of partly manufactured articles used by our own manufacturers as their "raw" material, and ordered by them as being, in their opinion, the most suitable to their purpose. Tariff Reformers would make them buy elsewhere at a higher price, and in some cases they would probably get an inferior article, whereas now they have the world's market to select from without restriction.

I note that the figures given by Mr. Glendenning were taken from the results of two similar firms, and he says that they represent a fair average, so that, for that particular trade last year, the German firms made a profit of 13 per cent. and the English firms all lost money. I should like to know what branch of the electrical trade is referred to.

As to the statement that "things may be too cheap," I do not think any manufacturer would object if his raw material—and all raw material is someone's finished article, even coal has to be mined and transported!—were given him free, at any rate, I have yet to come across the man who would. But there is no fear of any such catastrophe or millennium (according to whether one be producer or consumer) ever occurring, for the reason Mr. Glendenning himself gives, "nobody could live." How easy it is to make (and also to spoil) a case by "if's"!

A tariff may raise prices, as Mr. Glendenning hopes, according to their labour value, but there is no security that the value of labour will rise in proportion; *e.g.*, Mr. Bonar Law, one of the ablest advocates of Tariff Reform, said at Manchester, March 25th, 1907, "I do not believe that the proposed change in our fiscal system will tend to raise the level of wages in this country." I know that on the contrary many have promised it will do so, but whilst the doctors disagree amongst themselves there is no security for anyone.

Mr. Glendenning reports that the "main object of Protection is to encourage the exchange of our manufactures for other people's raw material" to which I referred in my last letter, but he does not bring forward a shred of evidence to show that this would result to a greater degree under Tariff Reform than at present.

As to the way things have worked out in the States under this "most desirable" system of tariffs, let the following extract from a recent issue of the *Wall Street Journal*, one of the two most influential financial papers in New York, answer him:—

"Such a tariff as our own is the most baleful moral handicap any nation ever placed upon itself. Its corrupting influence in politics goes without saying. The deterioration in our manufacturing products after 15 years of high protection is simply appalling. Respectable outfitters are selling now as cloth rubbish which they would not have allowed inside their store 15 years ago . . . Time was when the American manufacturer believed in holding his position by making something better than anybody else could make it. High tariff has taught him to make it worse than anybody else dare make it, securing immunity by protective import duties. Those rapid fortunes made in the packing, woollen, cotton and other industries, thanks to such protection, have corrupted other branches of business. There was a time when the retailer slowly and soundly built up a business by industry and intelligent service to the public. The idea now is to extract from the public all that it can be forced to pay under protection, not of probity and usefulness, but of a manufacturing ring prepared to make business impossible for independent honesty."

Having, I fear, Sir, already taken up too much of your valuable space, I must content myself with but a brief reference to "H. S. H." As he is not convinced *re* the Coal Tax, I can now only refer him to the *Cardiff Western Mail*, the leading Conservative and Tariff Reform paper in South Wales, particularly to a leading article which appeared on December 24th, 1907, on rumours that Tariff Reformers were in favour of reimposing the "incredibly stupid tax," under which "the British Mercantile Marine were the greatest sufferers." In its issue of the 2nd ult., another article equally strong appeared, of which the following is the concluding sentence:—"It (the Coal Tax) is the very antithesis of Tariff Reform, since it would destroy and not help to strengthen an industry."

As to the American mercantile marine, I do not know where "most students of American history" get their information from, but I get mine from the evidence given by experts before the Commission appointed by the Government, which amply supports my statement as to the cause of its decline and practical disappearance being due to the tariff under which it costs from 30 to 50 per cent. more to build ships than in the United Kingdom. If "H. S. H." has any better evidence to the contrary I shall be very thankful if he will let us have the benefit of it.

Troglodyte.

[While we publish this letter in deference to our correspondent's request, we do not wish to reopen the correspondence on this subject, which expired a month ago.—Eds. E.R.]

Publicity Literature.

We notice in your issue of last week a final letter from your correspondent, definitely refusing to substantiate his statements. This can only be taken to mean that he has abandoned the position.

We should like to recapitulate the facts. Your correspondent originally stated that he was in a position to place before the committee certain very advantageous terms. We challenged him to bring these forward as a test of his *bona fides*. In reply, he immediately abandoned his contentions. We are content to put these facts before your readers, and to leave them to judge the matter on its merits.

W. H. Smith & Sons' Advertising Agency.

London, *April 19th*, 1910.

Cost of Living in the Malay States.

In reply to the remarks by "The Writer of the Article" in your issue of February 11th, 1910, I should like to mention that it is rather curious to note that another correspondent, "One Who Lives There Now," writing in the issue of November 19th, 1909, also notices, at the very commencement of his letter, the fact that the writer must have lived there some time ago.

Apart from forgetting the possibility, or rather I should say, the probability, of conditions being different in other parts of the Settlements, I may say that in Singapore it is an understood thing that living in the Native States is *more* costly, not less, and very fairly accurate ideas are obtained here, as residents in the Native States frequently and regularly visit Singapore.

My primary reason for commenting on the article was owing to the value of the dollar being stated as being 2s., which showed that the writer must have left the Straits at least three or four years ago, and that his costs of living could not, therefore, be up to date; but the chief point to which I objected, that is, the great difference a newcomer would find in the monthly salary expected if he had worked it out on a 2s. basis, is not mentioned at all in the writer's reply.

I feel sure that, if the writer were to revisit the Straits now, he would alter his opinion as to my having exaggerated the cost; the figures I gave would, I think, be found a very fair average—most certainly not extravagant.

In conclusion, I think most readers will agree with me when I say that I think the writer would have done much better to have included the last four lines of his reply in the

original article. What a person *could* exist on in any particular part of the world is not very interesting; what one wants to know is how much he would have to spend in order to live reasonably (not extravagantly) like those with whom he will have to associate, say, generally speaking, the average class of person one meets in every-day life and business.

Precision.

Singapore, *March* 13*th*, 1910.

P.S.—I feel constrained to point out that I did not write in the first place merely for the sake of criticising the article, but because I have met so many young fellows who have been disappointed with regard both to the value of the dollar and to the cost of living, and, as mentioned before, in order that articles of this nature should be quite up to date and as accurate as possible, I would suggest that they be written (or, at least, revised) by someone actually resident in the particular part referred to at the time of writing. I trust, therefore, that the "Writer of the Article" will take my remarks in the spirit in which they were intended.

Electrically-driven Steamships.

In the interest of the electrical engineering trades, I respectfully wish to draw attention to a statement that Mr. Charles A. Parsons made at the discussion on a paper that I recently had the pleasure of reading before the Institution of Naval Architects, to the effect that if a short circuit occurred on board of an electrically-driven ship, all the men in the engine-room would be killed by copper poisoning, and therefore its adoption involved grave risks. This statement he repeated in the reply which he gave to the discussion on his paper the next day, on "The Transmission of Power by means of Mechanical Gears to Slow-speed Propellers from High-speed Turbines."

In view of such a strange statement being made by Mr. Parsons before one of our technical institutions when vast interests are at stake in the shipping world, the electrical engineering profession ought to ask Mr. Parsons to publicly withdraw such a statement, which is not only untrue, but is not a proper item to embody in any discussion on electrical power generation and transmission for ship propulsion, and at the same time may mislead a number of interested ship-owners to the extent of overlooking the great advantages that are to be obtained by the adoption of the latter for the purpose named.

I have endeavoured to find out a case in which any one has been poisoned by means of a short circuit on a generator of large power; perhaps some of the readers of this letter will kindly give their views, as it is of the utmost importance. Mr. Parsons's patent specification has been published on the 7th inst., and reading the same I can see he is following the ground over which I have gone years ago, as any one can see by reference to my patent, No. 17,248 of 1905. I might point out that it has no connection with my recent patents, which are under what is now well known as the "Paragon" system.

William P. Durtnall, M.I.Mar.E., M.I.Auto.E.

London, E.C., *April* 14*th*, 1910.

The Need for British Trade Aggression in Turkey.

The leading article on the above subject in your issue of the 15th has interested me, as it confirms my experience of the apathy of British manufacturers and financiers in so far as trade in Turkey is concerned.

In electrical matters, Turkey was certainly a virgin field until very recently. Developments have, however, taken place during the last two years, and my view is that Turkey will undoubtedly become a very important market. Our Continental friends, realising this, are already on the spot in large numbers.

My connection with that part of the world dates from my birth, and I did not hesitate, as soon as a Constitutional Government was established, in advising my board to open a branch in Turkey. We have every reason to be satisfied with our venture, and would like to increase our field of operations, but try as hard as one can we cannot induce British manufacturers or financiers to interest themselves in electrical and other schemes in Turkey.

We have had the offer of concessions for all kinds of projects—tramway and town lighting, mining, &c. In every case we have had to turn them down for the want of support. Our instructions to our Smyrna office now are that they are not to forward us particulars of any further concessions.

The lighting concession for the town of Smyrna is in the market, and I observe from your columns that the Constantinople authorities are now also inviting tenders. I know for a fact that not a single British firm excepting ourselves has tendered for Smyrna, and we are doing so in conjunction with a Belgian firm of manufacturers. The Constantinople concession will no doubt receive no more consideration at the hands of British manufacturers and financiers than has the Smyrna.

Your suggestion of commercial excursions is a good one, and one that ought to be acted upon before, so far as Turkey is concerned, it is too late, and the plums have been picked by the Germans. I am due for a visit to our Turkish branch this summer, and shall be happy to personally conduct a party such as you suggest.

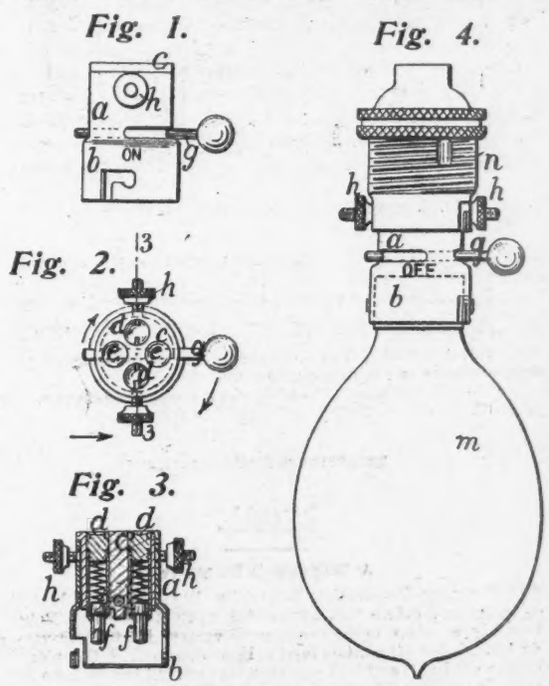
John W. F. Warren,
Chairman and Managing Director,
Warren, Beattie & Co., Ltd.

Middlesbro'-on-Tees, *April* 18*th*, 1910.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Wright's Patent Switch Adapter.

This invention has for its object to provide a device by the insertion of which an ordinary electric bayonet lampholder can be converted into a similar switch lampholder, without any alteration in the wiring and without detracting from the neat appearance of the lamp. It consists of a tube or barrel having a plug portion with pins for insertion into the bayonet-socket of the lampholder, and a bayonet-socket to take the lamp. Within the plug portion



Details of Switch Adapter.

is arranged to rotate a cylinder of insulating material having spring contact plungers within the socket, communicating with depressed contacts which engage the spring plungers in the lampholder. A handle projecting through slots in the barrel permits of rotation of the insulating cylinder through 90°, thus breaking the circuit at four points. In the "on" position the switch is lightly held by the contact plungers being pressed into the depressed

contact plates, while in the "off" position this is effected by providing blind depressions in the insulating cylinder.

Referring to the accompanying drawings: fig. 1 is a side elevation of the adapter, fig. 2 a plan, and fig. 3 a sectional elevation; fig. 4 shows the adapter in use.

The barrel is divided into two parts, a plug portion *a* fitting into the socket of the holder *n*, and a socket portion *b* to take the lamp *m*. The plug *a* has screwed pins with nuts *h* engaging with the bayonet-slots of the holder, the nuts serving to hold the adapter from rotation when inserted in position.

Within the plug portion *a*, is an insulating cylinder *c* with a shoulder to hold it in place. This cylinder has two spring plunger contacts *f* making contact to the lamp and communicating with depressed contact plates or studs *d*, which make contact with the plunger contacts of the lamp-holder.

A rod or handle *g* passes through a hole in the cylinder *c* and through two slots in the barrel, which allow the handle to be turned through 90° and at the same time prevent vertical movement of the cylinder *c*.

In a modified form of the adapter a lamp shade may be used, although provision may not have been made for a lamp shade on the lamp-holder.

The switch adapter will be found very useful for metal-filament lamps, as it forms a double-pole switch with a smooth switch action, and will be useful for isolating electric lamps which have been connected to wall brackets, electroliers, or cluster fittings, the wiring of which has been arranged so that more than one lamp is controlled by one switch. The plain switch adapter increases the length of the lamp-holder by about ½ in.

The licence to manufacture has been secured by the General Brass Fittings Co., Ltd., of Leeds, and 4, Oat Lane, Wood Street, E.C.

Auto-Combination Switch Plug.

This ingenious device, consisting of a combined 10-ampere switch and wall plug, with a patent automatic release, adds one more to the numerous electrical fittings for which Messrs. Lundberg and Sons have achieved a reputation. It has been designed to control with greater safety portable apparatus for lighting, heating, cooking, &c.

The switch movement is of the firm's standard "pivot" type, with variable leverage action, knife-blade contact arms, and double contacts. A horizontal spring plunger is embedded in the porcelain

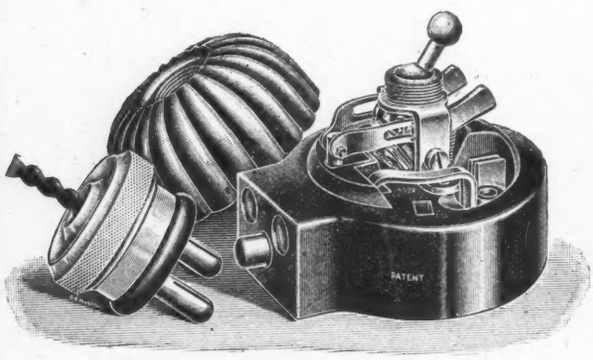


Fig. 5.—Lundberg Combination Switch-Plug.

base, and is linked to the rocking cradle of the switch arm in such a way as to control its operation. Thus the spring plunger automatically and instantly pulls the switch "off" when it is attempted to withdraw the plug, the rupture occurring in its proper place, viz., at the switch contacts. Moreover, the switch will not remain "on" unless the plug is in the socket. Any of the standard plugs or covers made by the firm can be fitted.

The 10-ampere fitting is a substantially constructed device. We gather that a similar 5-ampere fitting is on the way.

LEGAL.

A Consumer's Liability.

The Coventry Corporation Electricity Department took action on Saturday, before the magistrates, against Cornelius Roberts, formerly a hatter in business in Coventry, for the recovery of £2 14s. 6d. due for electric light. Defendant raised the plea that he was not liable as, three years ago, he had sold the business to his son. He submitted that the department had been receiving cheques in payment from his son, and would therefore see they were not his cheques, as they were signed P. N. Roberts. He admitted that up to a certain time he was liable. He told the collector that the business had been turned over to his son. The chairman of the Bench: But the Electric Light Department do not receive verbal notices. The Bench came to the conclusion that as the change in business was not publicly notified, nor had defendant given written notice that he was no longer liable, he must pay the claim, with costs.

Tramway Appeal.

In the Divisional Court of King's Bench on Saturday last, Mr. Justice Phillimore and Mr. Justice Bucknill heard an appeal against judgment and verdict in an action brought by Mr. Bernard Spencer, of 25, Caxton Road, Wimbledon, against the London United Tramways Co. in the Brentford County Court, before Judge Bray and a jury. The action was for damages for personal injury and the jury returned a verdict for the plaintiff, assessing the damages at £15. Against this the Tramway Co. appealed on the grounds of misdirection and that the verdict was against the weight of evidence.

The appeal was dismissed with costs.

Tramway Accident.

In the King's Bench Division on Tuesday, April 19th, Mr. Justice Scrutton and a common jury awarded Mr. John Edward Cutter, of Trinity Road, Southall, £350 damages against the London United Tramways Co. for personal injuries received whilst riding on the top of one of defendants' cars. Plaintiff said that the car jerked so violently whilst running from the main track on to a loop line at Southall, that he was thrown from his seat, and his head striking the seat opposite so seriously injured his left eye that he had had to have it removed. Medical evidence stated that the right eye was also affected.

The Electrical Co. *v.* Thomas, Son & Co.

The above action was continued before the Official Referee, Mr. Pollock, in the High Court this week.

Mr. Wales, mining engineer at Swansea, was called for the defence, and said that he had had 35 years' experience in the South Wales coalfields, was vice-president of the South Wales Institute of Engineers, and had known the mine in question for many years. A month would have been a fair and reasonable time to unwater the mine after the installation of the plant. Witness also gave expert evidence as to the quality and quantity of coal produced, the wages paid to the miners, &c. He thought that £20,000 would be a reasonable figure for a capital outlay in a mine which would produce an average of 300 tons of coal a day.

Cross-examined, Witness said that he estimated the amount to which defendants were entitled in respect of damages at £27,000.

Rebutting evidence was called by the plaintiffs, and Mr. F. B. Johnson, electrical engineer, said he erected the plant for plaintiffs in the defendants' mine. The machinery, he declared, was allowed to get into such a dirty condition by the defendants' men that it would not work properly, and the generating plant would not produce the required amount of power. The sump of the Allen pump was allowed to get into a very bad state, and the water was very dirty and thick with clots of grass floating in it. Witness mentioned occasions when the pump was not allowed to work in a sufficient depth of water, with the result that it drew air.

Mr. Sankey, K.C. (for plaintiffs): And if the pump were allowed to draw air what effect would that have on the electrical machinery? —It would have to be stopped.

Counsel: But supposing it were not stopped, and was allowed to run on?—It would heat up the pumps, machinery and bearings.

An Electric Lighting Assessment Appeal.

At the Liverpool County Quarter Sessions, on Tuesday, the Liverpool District Lighting Co., Ltd., appealed against the assessment in three different townships by the Rating Committee of the West Derby Union. Mr. Rigby Swift, counsel for the respondents, said the appeals were in respect of the generating stations in Waterloo, Crosby, and Seaforth, and of free wiring in the houses of consumers of electricity. At the present time the whole undertaking was rated at £740 net, and if the contention of the appellants was correct, that the expenditure of £7,510 in respect of the installation of free wiring must be regarded as tenants' capital, it would be agreed that the amount must be reduced to £350 net.

Mr. F. A. Greeb, for the appellants, contended that the outlay on the free wiring was that of a tenant undertaken for the purpose of increasing his business, and ought not to be taken into account in estimating the rateable value of hereditament.

The Chairman, after hearing further argument, stated that, in the opinion of the Court, some deduction ought to have been allowed in the valuation in respect of tenants' capital employed in wiring the houses. Having arrived at that conclusion, they were bound by the agreement that had been made to fix the rateable value at £350. They therefore allowed the appeals, with costs. The Chairman added that the figure was not one which the Court would have fixed had it been left to them.

Mr. Swift asked the Bench to state the case for a higher Court. This was agreed to.

International Congress of Mining, Metallurgy, Applied Mechanics and Practical Geology.—A provisional programme for this Congress, which is to be held at Düsseldorf this year, has been issued. The meeting will start in the last week in June, and, according to the American *Electrical Review*, some of the subjects for discussion include steam, gas and electrically-driven rolling mills; steam, gas and electrical power stations; electric winding engines, &c.

OUR LEGAL QUERY COLUMN.

[Questions addressed to this column should be written on one side of the paper only.]

"234 Middlesex" writes:—"We have up to the present taken our electric supply from the local company; average prices, power 2¾d., light 5½d. per unit. We are considering the question of putting in a generating set, still keeping our connections with the company in case of breakdown and for the use of our watchman and office at night. I should be obliged if you would let me know through the medium of your paper our position with regard to Electric Lighting Act, 1909, should we install the set.

*** The Electric Lighting Act, 1909, which has just come into force, does not in any way prevent a person or company putting in and using a private installation. It does, however, provide that, notwithstanding anything in a provisional order, a person shall not be entitled to demand or to continue to receive from undertakers authorised to supply electricity in any area, a supply of electricity for any premises having a separate supply, unless he has agreed with the undertakers to pay them such minimum annual sum as will give them a reasonable return on the capital expenditure, and will cover other standing charges incurred by them in order to meet the possible demand for those premises. The sum to be so paid shall be determined, in default of agreement, by arbitration. (See Electric Lighting Act, 1909, Sec. 15.) This appears to answer the query propounded. Before the Act of 1909 came into force, a consumer having a private installation was entitled to be treated like any other consumer; the company could not impose onerous terms upon him. Now, however, the use of the mains as a stand-by is to be subject to the above restrictions.

BUSINESS NOTES.

Business in the United States.—According to a German commercial journal published in New York, the gross sales of the three large American companies—the General Electric, the Westinghouse and the Western Electric—are very extensive at the present time. The improvement in business certainly does not reach the level which was expected a few months ago, and it actually shows a certain decline, as compared with the splendid situation of affairs in the autumn months of last year; nevertheless, the General Electric and the Westinghouse Companies estimate that the current year will represent record figures in the value of the new orders. The business reaching the three companies is stated to be at the rate of £30,400,000 per annum, or 18 per cent. in excess of 1909, and 145 per cent. greater than in 1908, the latter of which was the year of deepest depression, when the orders booked were of the value of £12,400,000. The following figures are given of the present course of business, as compared with the worst period in the year 1908:—

	Present rate of business.	Rate of business in the panic period in 1908.
General Electric Co. ...	£12,400,000	£5,600,000
Westinghouse Co. ...	6,000,000	2,400,000
Western Electric Co. ...	12,000,000	4,400,000
Total	£30,400,000	£12,400,000

It is added that the present rate of new orders of £6,000,000 in the case of the Westinghouse Co. contrasts with the announcement that the value of new orders received last November was at the rate of £7,200,000 per annum.

A.E.G. Aeroplanes.—Following the example of the Siemens-Schuckert Co., the Allgemeine Electricitäts Gesellschaft, of Berlin, is, it is announced, about to take up the construction of aeroplanes to the designs of Herr Stumpf.

Mining Specialities.—Among the specialities of the Electrical Trades Supply, Ltd., is a handy device which has been largely adopted for exposed wiring for motor supply, viz., the patent two-part porcelain insulator, in which the cable inserted in a slot at the side of the external part is clamped by an internal sliding portion held in position by the screw, which fixes the insulator in place. No binding wire is required, and the fixing represents a great saving of time over ordinary methods. The patent safety spring insulator, another of the firm's specialities, just put on the market, is of particular interest to mining engineers; it consists of a clip with bent ends, which are sprung over the sides of a porcelain reel insulator, placed horizontally, and press into the central hole on either side. The grip is a frictional one, and such as will allow the cable (which is strung over the reel) to break away in case of a fall, before it can be damaged—a condition required by Sec. 3, Clause 29, of the Mining Regulations. The firm are also makers of the E.T.S. water and gas-tight mining switch and fuses for 600-volt A.C. or D.C. circuits. In this apparatus, cartridge or porcelain handle fuses are fitted, and the lid cannot be opened to replace blown fuses, except with the switch in the "off" position.

Book Notices.—*Optical Instruments Simply Explained. Model Engineer* Series No. 35. 1910. London: Percival Marshall and Co. Price 6d. net.—In this little book the principles upon which the optical instruments in common use are based are simply explained; in these days a working knowledge of at least the elements of optical science is essential to the electrical engineer, particularly if he is engaged on lighting installation work, the manufacture of projectors, experimental work with oscillographs and similar apparatus, or photometry, and he will find most of the fundamental principles that he requires discussed in this book.

"*Journal* of the American Society of Mechanical Engineers." Vol. 32, No. 4. April, 1910. New York: The Society. Price $1.

"Modern Lightning Conductors." By Killingworth Hedges. London: Crosby Lockwood & Son.

"*Transactions* of the North-East Coast Institution of Engineers and Shipbuilders." Vol. XXVI, Part 4. April, 1910. London and Newcastle-on-Tyne: Andrew Reid & Co., Ltd.

"*Prospectus* of the Working Men's College, Melbourne." 1910. Melbourne: The College.

"*Journal* of the Western Society of Engineers." Vol. XV, No. 1. February, 1910. Chicago: The Society. Price 50 cents.

"Soldering, Brazing and the Joining of Metals." By Thomas Bolas. 1910. London: Dawbarn & Ward, Ltd. Price 6d. net.

Liquidations.—Amalgamated Dry Batteries, Ltd.—A meeting will be held at 394, Moorgate Station Chambers, E.C., on May 26th to hear an account of the winding-up from the liquidators, Messrs. S. H. Rogers and L. F. Goodricke.

City of Wellington Electric Light and Power Co.—A meeting will be held at 180, Dashwood House, E.C., on May 23rd to hear an account of the winding-up from the liquidator, Mr. H. E. Salt.

The National Lighting Corporation, Ltd.—This company is winding up voluntarily with Mr. F. J. Duck, 1 and 2, Bucklersbury, E.C., as liquidator.

Contraflo Condenser Co., Ltd.—A meeting of creditors is to be held at 3, Crown Court, E.C., on April 21st.

Trade Announcements.—Messrs. Tetley & Co. have given up their offices and showrooms at 20, Bucklersbury, London, E.C., and pending the making of new arrangements, communications should be sent direct to the Falcon Electrical Works, Bedford Street, Greengate, Salford.

The Unity Rubber Co., Ltd., of Woodley, near Stockport, announce that on May 1st their address will be Cobden Street, Pendleton, Manchester, and all communications should be sent there.

The Hart Manufacturing Co. inform us that on and after April 25th their address will be 77, Rochester Row, London, S.W.

Kabul.—H.H. The Amir has in course of construction some fairly large installations for lighting palaces, power for State workshop purposes and pumping; also a long-distance telephone scheme interconnecting various important centres with his Capital. The work has been entrusted to Messrs. F. & C. Osler, Ltd.

Bankruptcy Proceedings.—A. E. Felgate & W. Storey (trading as Felgate & Storey), electrical engineers, 10, Queen Victoria Street, Reading.—These debtors attended at the Assize Courts, Reading, last week, for their adjourned public examination. The statement of affairs disclosed liabilities £2,617, and assets £863, leaving a deficiency of £1,754. They attributed their failure to bad trade, heavy rent and loss at Oxford. The debtor Felgate said he started business about February, 1903, at Reading, with about £130 borrowed from the bank on security of 130 £1 shares in a certain company, which ultimately realised 2s. 6d. in the £, and about £600 borrowed from friends, which was still owing. Private meetings of creditors were held in January last, when a statement of affairs presented showed a deficiency of £1,433. At the first meeting a composition of 10s. in the £ was offered, and at the second meeting a composition of 5s. in the £, or a deed of assignment. Debtors stated that the majority of the creditors agreed, but one or two firms stood out. At the date of the receiving order the Sheriff of Berks was in possession under an execution at the suit of two creditors, and some other firms were suing the debtors. In December, 1909, the debtors handed a petrol engine and dynamo (cost £47) to creditors as part security of their debt, and the creditors gave the debtors credit for £20 in their account for it. Debtors stated that in December, 1909, they received a cheque for £250 from a friend for the purpose of paying some of the most pressing claims and adjusting affairs at the end of the year, but as creditors were pressing they returned the balance of the cheque after paying £60 for wages, and they gave a charge for this £60 on certain of the Oxford book debts. The only assets in Felgate's separate estate were furniture (£10), a motor bicycle (£4 10s.), and bicycle (£2). No liabilities were disclosed. The assets of Storey's separate estate were furniture (£10), and bicycle (£2), and no liabilities were disclosed. The debtors became aware of their position last December. The examination was adjourned.

Thomas Ward, formerly a director of the Electrical Instrument Manufacturers, Ltd., Freezywater, Waltham Cross, late of 22, Totteridge Road, Enfield Wash.—The debtor attended at the Edmonton Bankruptcy Court on Monday, when he was allowed to pass his examination. The receiving order against him was made as far back as September 28th, 1908, but owing to his ill-health the examination was repeatedly adjourned. Ultimately it was agreed that it should be taken in private, and recently the debtor was questioned at considerable length at the office of the Official Receiver, where the Registrar attended. The proceedings at Monday's Court were purely formal. Debtor's statement of affairs revealed a deficiency of £1,161.

H. K. P. Barham (trading as the South of England Electrical Engineering Co.), electrical engineer, 60, Fratton Road, Portsmouth, Hants.—The receiving order herein was made on the debtor's own petition, and according to the accounts filed, the liabilities to unsecured creditors amount to £357, while the net assets, which total £42, are insufficient by £57 to meet the claims of preferential creditors. It appears that the debtor started business as an electrical engineer in April, 1898, with a capital which comprised allowance and gifts from his father amounting to £90, of which £40 was invested in the purchase of his present premises, 60, Fratton Road, for £240, £200 remaining on mortgage. During the 12 years he has been in business he has been assisted from time to time by his father, to whom he is indebted to the extent of about £900. The debtor states that when the amount reached £500, about six or seven years ago, he suggested that his father should take the equity of the premises as part security, and the property was then conveyed to him, but no rent has been charged. The debtor has, in the course of his trading, made several arrangements with creditors with the assistance of his father, and has paid 5s. in the £ under an administration order. The business does not appear to have ever yielded sufficient to cover his trade expenses and maintenance. He attributes his failure to insufficient trade, losses on contracts, and personal illness for six weeks in January and February last year, and admits that he has been on the wrong side from the commencement. No losses on contracts appear to have been made until 1908, when, owing to non-completion within the stipulated time of an installation of electric plant, the work was placed in other hands, which meant an estimated loss to the debtor of £120. Immediately before the receiving order, the debtor failed to satisfy his customers in respect of another contract, the account being repudiated on the ground of excessive charges, this being the immediate cause of the petition. This is the book debt which the debtor has scheduled as doubtful and estimated to produce £10. The largest creditor, whose claim has been scheduled at £177, appears to have made advances from September, 1901, to February, 1904, of which £65 was on account of the patent and the balance advances on the debtor's I.O.U. The invention, which was patented in Great Britain, Germany, France, Belgium and America, has not resulted in practical value. All the patent rights have lapsed, excepting the American patent, which was taken out in 1903, and is still in force, but is said to have been infringed upon. The debtor has six apprentices, with each of whom a premium of £30 was paid, in respect of which £95 has been scheduled as preferential claims. No books of account appear to have been kept.

J. Platt & R. Bleasdale (Platt & Bleasdale, electrical engineers, Victoria Square, Bolton, Lancs.).—These debtors attended at the Court House, Mawdsley Street, Bolton, for their adjourned public examination last week, but there being no further questions to put to the debtors, the examination was formally closed.

Canada.—It is expected that now that the surtax has been removed from German manufactures, Germany will be a far more active competitor in the Canadian market. A report from the other side states that the mails to Canada are taking large numbers of German catalogues, price lists, and business connection propositions. Further, many German houses are said to be making arrangements to send special representatives to canvass for business throughout the Dominion.

Catalogues Wanted for Colombia.—The president of the Compania Anonima Electrica de Bucaramanga, Limitada, Apartado 16, Bucaramanga, Colombia, South America, writes asking for catalogues of electric motors to be forwarded to him. They should be preferably in French or Spanish, and give prices and discounts.

Fire.—There was an outbreak of fire last week at the electrical engineering works, occupied by Mr. Edward Dewhurst, Mount Street, Preston. The fire arose from the friction engendered by the emery wheel used for planing wood. The damage, confined principally to woodwork and machinery, is covered by insurance, and is estimated at £400.

The Fun of the Fair.—Most of our readers have at some time or other in their existence seen that revolving piece of wonderment possessing such luring attractions for the juvenile mind—the "merry-go-round." All of our readers, too, have seen a tantalum lamp, and have either heard or tested its claims to stand vibration, but as few can have met a "merry-go-round" lighted with such lamps, we have received an illustration from Siemens Bros. Dynamos Works of such, showing one of these holiday whirlers with lamps lighted, which have been successfully undergoing severe vibration test since November, 1908, at St. Kilda's Beach, Melbourne. We have not room to publish a view, but the effect at night may easily be imagined.

LIGHTING and POWER NOTES.

Acton.—The Metropolitan Electric Supply Co. has asked the Council to submit complete schemes for supplying factories with either alternating or direct current, with a view to arriving at the cost of giving such a supply. The matter arose out of the proposal to supply Messrs. Napier & Son at 1d. per unit; it has been agreed to supply Messrs. Panhard & Levassor on stated terms.

Aldeburgh.—The T.C. has decided to apply to the B. of T. for a prov. order for electric supply which, it is intended, will be carried out by the Rural Electricity Supply Co., of London. It is proposed to carry out the installation on the overhead system, and the company offers to undertake the public lighting all the year round at an inclusive charge of 35s. per lamp per annum, which would be a saving on the present lighting rate of 1d. in the £.

Ashton-under-Lyne.—On April 15th a L.G.B. inquiry was held respecting the Corporation's application for sanction to borrow £48,424 for the extension of the borough electricity works. It was stated that during the past three years applications for power, amounting to several thousand horse-power, have been made by local manufacturers, which the Corporation was not able to supply. In view of the Corporation's monopoly and of the recent inquiry in connection with another Lancashire town, brought about by a local company desiring to provide the necessary supply, it was highly desirable that the position of the Corporation should not be jeopardised, and that it should be competent to meet all the requirements of intending purchasers.

Australia.—The Hawthorn (V.) City Council has received a preliminary tender from the Melbourne Electric Supply Co. for electric lighting. The Council is being urged locally to extend the scheme over the whole of the municipal area. It is proposed to adopt a 14 years' agreement.

Bacup.—A L.G.B. inquiry was held on April 14th relative to the T.C.'s application to borrow £3,000 for electric lighting. Energy will be supplied by the Rawtenstall Corporation for a term of years, and the Bacup Council will lay its own cables, the cost of which will be refunded by Rawtenstall. The application was practically formal, and the Inspector expressed the opinion that the local council's risk had been brought down to an irreducible minimum.

Bolton.—Consent having been received from the Board of Trade under the Bolton Electric Lighting Order, for the use of land at Back-o'-th'-Bank, the electrical engineer (Mr. A. A. Day) has been instructed to prepare a scheme in connection with the proposed new power station.

Bootle.—The T.C. has decided to replace the existing pumping engine at the water station with two rotary pumps, electrically driven and capable of pumping 30,000 gallons of water per hour. A L.G.B. inquiry with reference to borrowing £1,375 for the purpose was held on April 13th.

Cardiff.—The city electrical engineer has entered into negotiations with the Llandaff and Dinas Powis District Council with a view to supplying it with energy in bulk, to meet the requirements of residents outside the city boundary.

Chichester.—The T.C. has decided by 12 votes to 5 to accept the tender of the local electric lighting company for public lighting for five years at £3 5s. per lamp. This will mean an annual saving of £80.

Continental Notes.—Sweden.—The municipality of the town of Skellefteau has resolved to extend the power station at the Finnforsen waterfall, belonging to the town, with a view to supplying some pulp mills and factories with electrical energy. For this purpose electric plant has been ordered from the Luth & Rasens Electrical Co., of Stockholm, and the order comprises a three-phase generator of 5,600 H.P., together with a transformer of 4,000 K.V.A. This generator will, in regard to size, be the second in Sweden, next to that at the Trollhättan waterfalls.

Croydon.—The Electricity Committee has received sanction to an estimated expenditure of £4,500 in replacing two dry-back marine boilers, erected in 1901, with two water-tube boilers.

Derby.—In order to cope with the growing demand for electrical energy, the T.C. proposes to lay down direct-current machinery. A tender amounting to £5,203 has been received for the contemplated works, which has been brought under the consideration of the L.G.B. The £5,203 is made up as follows:—Generators, £4,076; converting plant, £1,027; contingencies, £100.

Devonport.—At a meeting of the T.C., on Thursday last week, it was mentioned that the Electricity Committee had decided to make application to the L.G.B. for sanction to borrow £7,061 for the extension of mains in the Pennycomequick district.

Dundee.—At a recent meeting of the Electricity Committee it was mentioned that the actual amount expended on the new station and sub-stations was £103,000. The estimate was £100,000. The Lord Provost remarked regarding the building and equipment that the Corporation had got an excellent installation, and that there had never been any ground for reflection on anybody.

Edinburgh.—The T.C. has agreed by 20 votes to 17 for delay to proceed with the erection of three cooling towers at Dewar Place electric light station, and the provision of exhaust steam turbines at a probable cost of £45,000.

Felixstowe.—On Tuesday a L.G.B. inquiry was held with reference to an application by the U.D.C. for power to borrow £4,500 for providing additional plant in connection with the electricity undertaking. The engineer stated that £2,250 would be shortly required for extension of mains.

Fleetwood.—The District Council Electricity Committee has under consideration the completion of the scheme for improving the public street lighting.

Gillingham (Kent).—The T.C. has concluded an agreement with a laundry company for a supply of energy for power purposes at 1½d. per unit on a minimum annual consumption of 15,000 units.

A L.G.B. inquiry was held on April 12th into the application of the T.C. for a loan of £3,000 for the installation of a Diesel oil engine. The Inspector (Mr. H. R. Hooper) asked for the accounts to be put in order from March, 1908, and for this purpose he adjourned the inquiry *sine die*.

Gosport.—The Council has agreed to the lighting of certain tramway routes by electricity, all other streets being lighted by the gas company. The cost of the dual scheme (£1,612) shows a saving of £81.

Hastings.—In reply to a question put to the borough accountant at Friday's meeting of the T.C., it was elicited that the total net deficiency on the municipal electricity undertaking amounted to £11,043 up to March 31st, 1909. The deficiency up to March 31st, 1910, had not yet been ascertained. The whole of the £11,000, the accountant explained, had been met out of the rates. The sum of £2,000 had been included in the current rate to meet last year's anticipated deficiency.

Japan.—The Tokio Electric Light Co. is increasing its capital from 24 million yen to 50 million yen, for the purpose of proceeding with its second programme of hydro-electric power generation and distribution.

King's Lynn.—At a recent meeting of the T.C. the Electricity Committee reported that in preparing the estimate for street lighting for the coming year, it had been agreed that the charge should be £2 10s. per lamp of 50 c.p. For the past year the charge was £3 per lamp, so that on the 518 lamps there will be a saving of £259. The recommendation was adopted.

Kirkheaton.—The Yorkshire Electric Power Co. has applied to the B. of T. for sanction to use overhead lines for supplying energy to the Helm Colliery, Kirkheaton. The line will commence at Dewsbury.

Litherland.—The B. of T. has extended the E.L. order for a year.

London.—Westminster.—The City Council having considered the competitive tenders of the Gas, Light and Coke Co., Ltd., and St. James' and Pall Mall E.L. Co. as to street lighting in streets at present lighted by gas and for districts at present lighted by 71 arc lamps (including Regent Street and Piccadilly), has decided, on the score of lesser cost of maintenance, to accept the tender of the gas company. The Works Committee of the B.C., before reporting, viewed the experimental arc, metal-filament and gas lighting in Victoria Street and the gas lighting in Fleet Street. The difference in cost for 3,940 hours for a 90 c.p. unit amounted to 76 per cent.; 180 c.p., 77·7 per cent.; 300 c.p., 80·7 per cent.; 1,800 c.p., 33·8 per cent.; and 3,000 c.p., 29·5 per cent. In Regent Street and Piccadilly it is intended to supersede the 3,000-c.p. arc lamps by gas lamps of the same power on the same posts, but apparently the shopkeepers there do not view the proposed change to *nominal* 3,000-c.p. gas lamps with equanimity, as they presented a petition asking for the matter to be adjourned for further consideration.

Islington.—The model wiring rules prepared by the Institution of Electrical Engineers are to be adopted by the Council, subject to any technical variation that the borough electrical engineer may find necessary in any particular case.

Bethnal Green.—The Electricity Committee of the B.C. has again had under consideration the question of a supply of electricity to the borough, and is of the opinion that the Council should enter into a contract with the Shoreditch B.C. upon the basis of its alternative flat-rate scheme, for a period of seven years.

Stepney.—In connection with experiments to reduce the smoke emitted from the chimney at the Whitechapel generating station, arrangements were made some time ago to test the Crosthwaite furnace. The electrical engineer and manager reports that the result of the experiment is quite satisfactory, and the apparatus is to be purchased at £145.

Manchester.—The City Council has agreed to the Electricity Committee borrowing £40,000 for the extension of the electric supply undertaking.

Penzance.—At a meeting of the T.C. on Wednesday, the town clerk reported the receipt of a letter from Mr. W. T. Prestland, as to the Penzance Electric Lighting Order. He stated that one of the directors of the Cornwwall Electric Power Co. had been to Hayle and Penzance, and he could state that he would advise the board to proceed with the supply of electricity to Penzance. After the meeting (held last Thursday week) he should be able to place a proposition before the Council and the B. of T., which would satisfy them that a definite date would be given for the supply of electricity. The letter was referred to the Electric Lighting Committee.

Stalybridge.—The Joint Electricity and Tramways Board has applied to the L.G.B. for loans of £15,000 for mains, £5,000 for transformers, £968 for a coal elevator, conveyors and bunkers, and £1,300 for mechanical stokers.

Tasmania.—The Devonport Council has adopted the scheme proposed by its engineer, Mr. G. H. Lofts, to extend the electric supply to East Devonport, and to make considerable alterations to the power plant. A poll of the ratepayers will, however, have to be taken before the work can be proceeded with.—*Australian Mining and Engineering Review.*

Warrington.—The T.C. has applied to the L.G.B. for a loan of £7,420 for a 1,000-kw. turbo-alternator, rotary converter, and switchgear.

Wigan.—The L.G.B. has sanctioned a loan of £32,400 for the extension of the Corporation electricity works.

Wokingham.—As the bulk supply provisions have been withdrawn from the Reading and District Electric Supply Bill, the Wokingham Council has decided to withdraw its opposition.

TRAMWAY and RAILWAY NOTES.

Australia.—Melbourne.—The Prahran, Malvern, Caulfield and St. Kilda Councils propose applying to the Governor-in-Council for an order empowering them jointly to construct an electric tramway along Dandenong Road, and to connect with the Prahran-Malvern system now under construction. Mr. J. H. D. Brearley, of Messrs. Noyes Bros., has been asked to report on the scheme.

The Geelong T.C. has attached its seal to the deed delegating its power to construct electric tramways to the Melbourne Electric Supply Co. Some alterations were made in the draft deed at the instance of the Crown Solicitor, and the London board of the company is at present considering these alterations.—*Australian Mining and Engineering Review.*

Belfast.—The City Council has unanimously agreed to proceed with the Bill authorising the proposed purchase of the Cavehill and Whitewell Tramways. A ratepayers' meeting is to be held to confirm the proceedings.

The report of the manager on the tramways undertaking for the financial year ended 31st ult., shows that the total revenue amounted to £203,875, an increase of £8,832. The working expenses amounted to £107,575, a decrease of £1,307, leaving a working profit of £96,301, an increase of £10,139. The net revenue charges, including interest on debt, the annual fixed payment of £8,961 to the general purposes fund, and other items, amounted to £50,244. The new revenue (for disposable profit) amounts to £46,057, being an increase of £8,410.

Brazil.—Telegrams from Belem, the capital of Para, state that, owing to the want of motormen, the service of the electric cars (owned by the Para Electric Railways and Lighting Co., Ltd.) in that city has been very irregular. The people strongly objected to this, and on March 15th attacked the cars, breaking and setting fire to several. The Englishmen employed by this company were also subjected to a considerable amount of hostility. The manager of the company has lodged a protest with the English Consul at Para against this outrage. The damage is estimated at 80 contos of reis (about £5,000).

Continental Notes.—Norway.—In the annual report of Christiania Electric Tramway Co. for 1909 it is stated that the total number of km. run during the year amounted to 2,491,757 (1,520,000 miles), and the total revenue was kr. 863,678 (£48,000). The increase in traffic combined with a more frequent (5-min.) service on all lines has made a considerable extension of the rolling stock necessary, as well as of the power station. On account of the more frequent service the revenue per km. has decreased, while the expenses show an increase on account of the licensing fees to the municipality having been raised. Notwithstanding this the net profits amounted to kr. 125,839 (£7,000), with which 8 per cent. was paid in dividends to the shareholders.

Russia.—The municipal authorities of Perm, in the Urals, have lately granted a concession to an English syndicate for the construction and working of an electric tramway in the town.

Croydon.—A petition signed by 1,700 persons, urging the re-opening of the Whitehorse Road route, which has been closed since June, 1908, owing to the loss incurred in working, has been received by the Tramways Committee, which has declined to make any recommendation to the B.C. The Easter holiday traffic showed an increase of £184 compared with 1909. The period allowed by the Croydon Corporation Act, 1905, for an extension of the tramways from Addiscombe to South Norwood *via* Woodside closes on June 30th next. The question of getting the powers extended is being considered.

Dundee.—A Sub-Committee of the tramways department has been apointed to confer with representatives of the Electricity Committee in the endeavour to arrive at an understanding on the question of cheaper electricity. Two years ago, when the last concession was made to the tramways department, the T.C. recommended that if the consumption amounted to 2½ million units per annum, a further reduction should be made. It

is stated that the consumption for last year was over 2½ million units. The Committee's idea is a penny per unit flat rate for both power and lighting.

At a meeting of the Tramways Committee it was agreed that the manager be instructed to report upon a proposal before the meeting for the discontinuance of the half-penny fare and the adoption of a universal penny fare from the High Street.

Glasgow.—The Corporation is to be represented at the International Tramways Conference in Brussels by two members of the Tramways Committee, together with the general manager and the engineer of the department.

The T.C. has acceded to the request of the Manchester Corporation, asking it to allow Mr. Dalrymple, the general manager of the tramways department, to give evidence for the Corporation in an arbitration which is to take place in London this month, relative to a dispute as to the working of tramway lines in Stretford, leased to the Manchester Corporation.

Japan.—A new electric tramway between Hyogo and Suma has just been completed and opened for traffic.

Leeds.—The report for the year ended March 31st last shows that a surplus of £46,000 was estimated on the tramways undertaking. The year has been an exceptionally good one, and there will be a sum of £55,317 available for the relief of the rates. This sum is obtained after providing £18,528 for direct payment of rates and taxes (an increase of £2,200 on the previous year). Total revenue was £357,610, against £342,001, and working expenses £184,191, against £178,324 for the previous year. After deducting the working expenses a sum of £173,419 is left, against £163,677 last year. Of this £43,659 is absorbed in paying interest on capital, £4,763 in income-tax on profits, £42,866 in contribution to the sinking fund and £3,082 in permanent way renewals. The sum available for the relief of the rates is £55,317. Adding the amount of profits to be applied to the relief of the rates to the sum of £18,528 contributed directly to the rates, gives a total contribution to the rates of the city from the tramway concern of £73,845. The report and accounts were adopted by the Committee on Monday.

Liverpool.—An improved type of tramcar has been constructed as an experiment, on the instructions of the Tramways Committee. The car is fitted with rattan cross seats on the lower deck, and has seating accommodation for 26 passengers, as against 20 in the present type of coach. On the upper deck, the seating accommodation has been re-arranged in order to afford better facilities for entering and leaving, and there are seats for 38 persons. The car has a 7 ft. 6 in. wheel base, which gives it much smoother running. The Corporation's own workmen built the car, which was turned out at the Lambeth Road Works, and on Saturday passed the Committee's inspection.

London.—Owing to the increasing popularity of the automatic ticket delivery machines which have been placed in Tube and District stations, the management of the Bakerloo, Piccadilly and Hampstead lines have ordered 25 more, making 50 in all. Recently 76,000 tickets were issued by the machines in one week.

L.C.C.—The Highways Committee reports that the traffic receipts for the year ending March 31st last were £1,845,444 from electric tramways and £122,505 from horse tramways, making a total of £1,967,949, which figure compares with £1,801,477 in the previous year.

Manchester.—The accounts for the year ended March 31st last show that the tramway receipts were £777,220, or £3,185 more than those of the previous year. The earnings per car per mile have slightly increased, and the number of car-miles run was rather less. There was also a greater number of passengers, the figures being 159,049,096, as compared with 155,011,884 for 1908-9.

The estimates for the coming year show £60,000 for the relief of the rates, which is £15,000 less than the amount allocated last year. Half wages to sick workmen alone means an addition of £5,400 to the expenditure, and rates arising out of track responsibilities have gone up £8,000. For renewals it has been found necessary to set aside the sum of £82,537. The amount of rates now paid by the department is £40,500. It is expected that the approximate income will be £797,725, against £788,011 last year. For power £123,971 will be required, £233,789 for traffic expenses, £75,400 for general expenses, £90,625 for rolling stock, permanent way, overhead equipment and buildings, £82,537 for renewals, &c., £48,709 for sinking fund, and £45,740 for interest on loans, &c. The amount contributed by the tramways in relief of rates since the Corporation took over the undertaking has been £452,000. The estimates for the current year were adopted by the Tramways Committee on Tuesday.

Newcastle-on-Tyne.—At a meeting of the City Council on the 6th inst., the chairman of the Corporation Tramways Committee stated that the total receipts for the year ended March 31st, 1909, were £209,540, as compared with £209,678 for the year ended March 31st, 1910, an increase this year of £138. The mileage for the year ended March 31st, 1909, was 4,289,997, and for the year ended March 31st, 1910, it was 4,430,085, an increase this year of 140,088. The number of employés on March 31st, 1909, was 945, and on March 31st, 1910, it was 888, a decrease of 57.

Oswaldtwistle.—The Council has decided to apply for a prov. order for electric lighting, one reason for this step being that, if desired, a ratepayer can apply to Accrington or Blackburn for a supply under present conditions.

Rawtenstall.—The B. of T. has approved the Corporation's prov. order authorising the construction of the Lumb Valley line.

Southampton.—The manager of the tramways has been authorised to purchase controller regulators at an estimated cost of £137 10s. The regulators are for the purpose of making it impossible for a motorman to rush his car at starting, and the manager is convinced that the first cost of these will be saved in a reduced use of energy within six months, in addition to a saving on the life of the equipments.

U.S.A.—A Baker electric motor-van has recently been added to the motor equipment at the White House, Washington. It is to be employed in conveying packages, and the personal luggage of the American President, to and from the steamship wharves and railway stations. The vehicle, which is adapted to carry loads of about 10 cwt., is equipped with a 42-cell battery, the necessary charging current being supplied from the electric lighting plant at the U.S. War Department building in Washington.

TELEGRAPH and TELEPHONE NOTES.

American Marconi Wireless Telegraph Co.—According to the *Electrical World*, a special meeting of the stockholders of the Marconi Wireless Telegraph Co. was called for April 18th to vote upon the proposition of reducing the capital stock from $6,650,000 to $1,662,500. This will be accomplished by reducing the par value of each share from $100 to $25. This reduction is being made in order to reduce the taxation charges that are now imposed. The company will save $4,500 per year by this reduction. Of the capitalisation $5,494,269 is carried in the balance-sheet as "patents and rights."

Argentina.—A 30 years' concession has been granted to Mr. Edward Richards for the establishment and working of a telephone system, to extend from Ultima Esperanza (Santa Cruz) to the 30th section in the southern zone of Santa Cruz, with a branch to the Gallegos-Punta Arenas telephone line.

Cross-Channel Telephones.—In addition to the new London-Paris telephone cable, to be laid between Dover and Cape Grisnez shortly, preparations are being made for laying an additional telephone cable across the Channel to Belgium. The Continental telephone cables have been so successful that the demand for their use has far exceeded anything that was anticipated. The new cable contains four wires, giving two complete circuits, and will be laid between St. Margaret's Bay, Dover, and La Panne, near Ostend. There are now eight distinct telephonic services, and they are quite unequal to the demand.

Glasgow.—There has been much correspondence, extending over a considerable space of time, between the Watching and Lighting Committee of the T.C. and the Postmaster-General. The point in dispute arose out of a letter by the Postmaster-General, which was to the effect that it having been reported to him that telegraphic communication had been established by means of circuits between fire stations in the city and a number of fire alarm posts, he had been advised that the use of these circuits by members of the public infringed the exclusive telegraph rights conferred on him by the Telegraph Act of 1869, 32 and 33 Victoria cap. 73, but that he was prepared to sanction the continued use of the circuits on the conditions set forth in that communication. It was resolved that the demand made by the Postmaster-General be not agreed to. At the last meeting of the Committee a letter was read from the Secretary of the Post Office, stating that the judgment of the House of Lords, of April 2nd, 1909, in the case of His Majesty's Postmaster-General *v.* the National Telephone Co., confirmed his contention that the use of wires of this description infringed his exclusive privilege, but that he was willing to consent to the continued use of those alarms on the undermentioned conditions:—(1) The circuits to be used for fire alarm purposes only; (2) the payment annually in advance, as from January 1st last, of a nominal royalty of 1s., in recognition of the Postmaster-General's exclusive privilege; (3) the execution, if at any time required, of an agreement similar in terms to a draft submitted, and (4) the removal of the wires at three months' notice if required. The town clerk stated that he was of opinion that the claim now made by the Postmaster-General was not warranted in law, and the Sub-Committee authorised him to repudiate the claim.

Trans-Atlantic Wireless Service. — The Marconi Wireless Telegraph Co., Ltd., announce that their trans-Atlantic service between Europe and America will be opened to-morrow, April 23rd, from which date the company will maintain a 24-hour telegraphic service for commercial and other purposes. Messages will be received at the company's offices, Watergate House, York Buildings, Adelphi, London, W.C. For Eastern Canada the rate will be 7½d. per word for coded messages, with a minimum of 10 words, and 5d. per word for non-coded messages. For distant parts of Canada the rates will be 4½d. per word less than the existing telegraph rates.

Wireless Telegraphy in the U.S.A. Navy.—The *Electrical World* gives particulars of the experimental trials now being carried out by the U.S.A. Navy Department with a view to ensuring certainty of communication over great distances. It is intended to erect a "master" station at Washington, with an iron mast 600 ft. high, and transmitting apparatus of 50-KW. capacity. Other naval stations will be equipped with 25-KW. apparatus, and battleships and first-class cruisers will have 10-KW. installations, all of high frequency and capable of communicating over a distance of 1,000 miles, not only by night, but also by day—a much more difficult feat. The National Wireless Telegraph Co., makers of the Fessenden apparatus, have secured the contract, and are carrying out trials to meet the specified conditions, with the aid of naval vessels equipped with the Fessenden system.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—QUEENSLAND.—June 8th. Six sections of common-battery switchboard and equipment, jumper wire, and cable, for the P.M.G.'s Dept. Tender forms, &c., at the Commonwealth Office, London, S.W. See "Official Notices" April 1st.

May 17th.—1,010 reinforced concrete telegraph poles, for the P.M.G.'s Department, Victoria. Forms, &c., at the Commonweaith Offices, London. See "Official Notices" April 1st.

May 18th.—Paper-insulated, lead-covered, and brass ribbon-tape cable, for the P.M.G.'s Department, Queensland. Forms, &c., at the Commonwealth Offices, London. See "Official Notices" April 1st.

June 8th.—Protectors, small switchboards, and common-battery telephones, for the P.M.G.'s Department. See "Official Notices" April 15th.

NEW SOUTH WALES.—June 1st. Eight sections of common-battery switchboard, for the P.M.G.'s Department. See "Official Notices" April 15th.

May 17th.—Fifty coin attachments for the P.M.G.'s Department in Victoria. See "Official Notices" to-day.

Barnes.—The electrical engineer is to invite prices for the supply of one mile of distributing cable.

Bristol.—April 30th. Arc lamp carbons and incandescent electric lamps, for the Docks Committee, for one year. W. W. Squire, engineer, Cumberland Basin, Bristol.

British Columbia.—May 3rd. Boilers, engines, condenser pumps, piping, and electrical apparatus for the Electric Light Committee, of Prince Rupert. Copies of plans and specifications can be seen at Commercial Intelligence Department of Board of Trade in London.

Canada.—Public Utilities Committee of Brandon. Steam-electric power plant (four units of 250 H.P. each) to supply tramways, street lighting, &c. Also electric power plant burning natural gas for the authorities of Medicine Hat. Apply to Board of Trade Commercial Intelligence Department, London.

Erith.—April 25th. Wiring scheme for three years, for the U.D.C. See "Official Notices" April 15th.

Germany.—The municipal authorities of Lauchhammer are about to invite tenders for the establishment of a large central electric lighting station.

The municipal authorities of Dortmund are about to invite tenders for the extension of the electric tramway system at an estimated cost of £100,000.

The municipal authorities of Ludwigsburg are about to invite tenders for the construction of an electric tramway.

Glasgow.—The T.C. invites tenders for the supply and erection of electrically-driven travelling lime-mixers, valves, &c., for the sewage works at Dalmarnock. Mr. A. W. Myles, Town Clerk, City Chambers.

Heston and Isleworth.—May 11th. Extension of the engine room. 250-KW. generating set, boiler feed steam pump, ejector condenser, piping and connections, machine tools, &c., for the U.D.C. See "Official Notices" to-day.

Ipswich.—April 27th. Concentric feeder (·3 sq. in.) and multicore cable, for the Corporation. See "Official Notices" to-day.

Lanark.—May 4th. The District Committee of the Middle Ward of the County of Lanark invite tenders for the supply and erection at the refuse destructor at Bogs Brae, near Bellshill, of one 3-KW. steam dynamo, one switchboard and main cable, and complete wiring installation. Specification at the office of Mr. A. J. Abraham, resident engineer, Electricity Works, Bothwell Street, Cambuslang; deposit £1, returnable as usual.

Leeds.—May 9th. 5¼ miles of ·15 sq. in. extra-high-tension three-core cable, for the City Electricity Department. See "Official Notices" to-day.

Littleborough.—May 2nd. H.T. feeder cables, L.T. distributors, &c., and transformer kiosk, transformers, equipment, switchgear, &c., for the U.D.C. See "Official Notices" April 1st.

Llandudno.—April 23rd. Replating battery, paper and vulcanised cable, feeder and distributing pillars, joint boxes, &c., for the U.D.C. See "Official Notices" to-day.

London.—L.C.C.—May 4th. Wiring and fitting at Fairclough Street and Amberley Road schools. See "Official Notices" to-day.

Manchester.—April 22nd. Five 600-KW. motor-converters or rotary converters and static transformers, for the Corporation Electricity Committee. See "Official Notices" April 8th.

Newport.—May 2nd. 1,000-KW. double-current turbo-generator, or 1,000-KW. turbo-alternator, with the surface condenser, for the Corporation. See "Official Notices" to-day.

Nuneaton.—April 25th. Water-tube boiler, feed-pump, pipework, valves, &c., for the Borough Electricity Department. See "Official Notices" April 8th.

Spain.—May 14th. The municipal authorities of Salamanca are inviting tenders for the concession for the electric lighting of the town.

Tasmania.—LAUNCESTON.—June 13th. Overhead electric equipment of tramways for municipal authorities, June 27th. Synchronous motor-generators and battery, reversible booster, &c. Tenders in both cases to Mayor and Aldermen, Town Hall. Conditions, &c., from Town Clerk, (one guinea deposit each specification).

Turkey.—May 28th. H.M. Consul at Constantinople (Mr. A. T. Waugh) reports that tenders are invited by the Turkish Ministry of Commerce and Public Works for a concession for the supply to the city of Constantinople of electrical energy. See this column of our last issue for fuller particulars.

Walthamstow.—April 22nd. One feeder booster set, and switchboard and accessories. See "Official Notices" April 1st.

War Office.—May 4th. Two electrolytic hydrogen and oxygen producing plants for the South Farnborough Balloon Factory. See "Official Notices" April 15th.

West Bromwich.—May 2nd. 750-KW. D.C. turbo-generator and surface condenser for the Corporation Electricity Department. See "Official Notices" April 15th.

Whitehaven.—May 2nd. Green fuel economiser, feed and other piping, main switchboard for the Corporation Electricity Department. See "Official Notices" April 15th.

Whitwood.—April 28th. Materials in connection with the proposed electricity supply, for the U.D.C. See "Official Notices" April 8th.

CLOSED.

Aberdeen.—The tender of Mr. William Tawse, amounting to £6,248, has been accepted for recausewaying the Woodside tramway track. The work has to be completed within six weeks.

Bootle.—The T.C. has accepted the tender of the Northern Electric Co., of Liverpool, for the E.L. installation at the Girls' Secondary School, at £89.

Glasgow.—The following contracts have been accepted by the Tramways Committee:—

Steel storage bins and lockers for Newlandsfield depôt.—Estler Bros.
Carbon brushes for rotary converters.—Le Valley-Vitae Carbon Brush Co.
Copper rail bonds.—Forest City Electric Co.

The Electricity Committee has accepted the following tenders for year's supply of stores:—

Low-tension cables and flexibles.—Callender's Cable and Construction Co., Ltd.
Rubber-covered cables.—Craigpark Electric Cable Co.
Meters.—Chamberlain & Hookham; Ferranti, Ltd.; British Thomson-Houston Co.
Carbons.—Sloan Electrical Co., Ltd.
Malleable-iron tubes and fittings.—D. Richmond & Co.
Troughing.—Brownlee & Co., Ltd.

Consideration of tenders for the supply of high-tension cables was continued, and the engineer instructed to submit new offers.

Government Contracts.—The following tenders have been accepted by the Government Departments named:—

WAR OFFICE.

Conduit fittings.—Barton & Sons, Ltd.; Credenda Conduits Co.; General Electric Co.; Nettlefold & Sons, Ltd.; Perfecta Seamless Steel Tube and Conduit Co., Ltd.
Motors.—Lancashire Dynamo & Motor Co., Ltd.
Motor-generators and switchgear.—Electric Construction Co., Ltd.

INDIA OFFICE, STORE DEPARTMENT.

Insulators.—Bullers, Ltd.
Manganese blocks.—Siemens Bros. & Co.

GENERAL POST OFFICE.

India-rubber and cotton-core cable.—Western Electric Co.
Paper-core cable.—Johnson & Phillips, Ltd.; Western Electric Co.; British Insulated and Helsby Cables, Ltd.
Submarine cable.—India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
Loading coils.—Western Electric Co.
Flexible cords.—British Insulated and Helsby Cables, Ltd.
Earthenware ducts.—Stanley Bros., Ltd.
Telegraph paper.—Colley's Patents, Ltd.; Waterlow & Sons, Ltd.
Telephones.—British L.M. Ericsson Manufacturing Co., Ltd.
Four electric lifts at the Head Post Office, Newcastle-on-Tyne.—A. & P. Steven.
Local telephone exchange equipment installation at the Post Office premises in Dalrymple Street, Kirkintilloch.—Western Electric Co., Ltd.

Gravesend.—The T.C. has accepted the following tenders:

Chloride Electrical Co.—Overhauling and repairing traction storage battery, £375.
British Thomson-Houston Co., Ltd.—Lamp stores.
Sutton & Co.—Cable troughing.
Bastian Meter Co.; The Electrical Co., Ltd.; Ferranti, Ltd.; and British Thomson-Houston Co., Ltd.—Meters.

Heywood.—The Electricity Committee has accepted the tender of Messrs. W. T. Glover & Co., for cables, as specified. The tender of Messrs. W. Chadwick & Son, for the purchase of old copper and lead, has also been accepted.

London.—Messrs. J. G. Childs & Co., Ltd., have just received an order for 14 electric lifts from the Great Eastern Railway Co., for the Liverpool Street Hotel.

HAMMERSMITH.—After further consideration of the tenders received for carbons, the Electricity Committee has recommended that that of the Sloan Electric Co., for Conradty (open type) carbons be accepted and that of Messrs. H. G. Mayer & Co., for Stella (enclosed type) carbons. The contract for electrical goods has been placed with the Edison & Swan Co.

For non-conducting composition to cover a boiler and steam piping the contract has been placed with Messrs. Hobdell, Way and Co.

L.C.C.—The Stores and Contracts Committee has placed orders as follows:—Insulating varnish for tramway purposes, Pinchin, Johnson & Co., Ltd. Steel bars for magnetic brake shoes, Frodingham Iron and Steel Co., Ltd.

The Highways Committee recommends the acceptance of the tender of W. McGeoch & Co., Ltd., (£144) for 545 roof light fittings for 90 double-deck electric cars.

From tenders submitted by six selected firms for six conduit-cleaning trucks, that of the Deptford Engineering Co., at £152, is recommended. The tenders ranged from that figure up to £357.

The tender of Walter Scott, Ltd., for 2,000 steel fishplates, at £10 10s. per ton, has been accepted.

The following tenders were received from selected firms, for the supply of (1) 500 moulded rubber plough bases, and (2) 916 moulded rubber plough leads for electric cars and traversers:—

	(1)	(2)
	s. d.	s. d.
J. G. Ingram & Son	37 6 each	8 8 each
India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.	53 0 „ (less 2½ per cent. discount)	3 10 „
Dermatine Co., Ltd.	95 0 each	6 6 each
David Moseley & Sons, Ltd.	—	11 2 „

The lowest tender, viz, that of Messrs. J. G. Ingram & Son, amounting to £1,086, has been accepted.

SOUTHWARK.—The B.C. has accepted the following tenders:—Electrical Co., Ltd., 10 H.P. motor, £36; Willans & Robinson, Ltd., supplying spare parts for engine, £67.

STEPNEY.—After three months' trial at the Whitechapel station the Electricity Committee recommends the taking over for £145 of the Crosthwaite furnace installed by the Crosthwaite Fire Bar Syndicate, Ltd, the experiment having been quite successful.

Lowestoft.—The T.C. has accepted the tender of W. G. Murrin, of Lowestoft, for free wiring up to a total of 200 lamps, at 8s. 8d. per point.

Madrid.—Messrs. Grice's Gas Engine Co., Ltd., of Carnoustie, have recently obtained, in the face of competition, an order for eight gas engines and suction producer plants for Messrs. Godinez, Moreno & Co., cement manufacturers, Madrid.

St. Annes.—The tender of Messrs. E. Taylor & Co., Ltd., of Littleborough, has been accepted for the erection of a chimney shaft, 180 ft. high, at the St. Annes Electricity Works.

Stalybridge.—The Joint Tramways and Electricity Board has accepted the tender of Messrs. Bennis for two stokers; and that of Messrs. Graham, Morton & Co., for a coal elevator, conveyors and bunkers.

Southampton. — The following tenders have been accepted in connection with the tramway undertaking:—

John Douglas.—Construction of tramways from Clock Tower and Northam Toll Bridge, £2,8 7.
Walter Scott, Ltd.—400 tons of tramway rails, £7 per ton.
Imeson, Finch & Co.—130 steel poles, £3 19s. 9d. each, also 130 cast-iron pole bases and 150 finials, £112.
Edgar Allen & Co., Ltd.—Ten pairs of points, £34 per pair; 10 sets of crossings, £13 each; and 10 tons of rails for curves, £43 per ton.

The tender of the British Thomson-Houston Co. for the annual supply of lamps was accepted at £60, for Edison lamps.

Whitehaven.—The Lighting Committee of the T.C. has accepted the tender of Messrs. Babcock & Wilcox for a boiler; and that of the Phœnix Dynamo Co., for a 2-H.P. motor for driving the mechanical stoker.

FORTHCOMING EVENTS.

Physical Society.—Friday, April 22nd. At 5 p.m. At the Imperial College of Science, South Kensington, S.W. Paper on "The Magnetic Balance of Curie and Cheneveau," by Messrs. C. Cheneveau and A. C. Jolley.

Royal Institution.—Friday, April 22nd. At 9 p.m. Discourse on "The Telegraphy of Photographs, Wireless and by Wire," by Mr. T. Thorne Baker.

Institution of Electrical Engineers (Newcastle Section).—Monday, April 25th. At 8 p.m. At the Armstrong College, Newcastle. Paper on "Earthed *v.* Insulated Neutrals in Colliery Installations," by Mr. W. W. Wood.

Faraday Society.—Tuesday, April 26th. At 8 p.m. At the I.E.E., 92, Victoria Street, S.W. General discussion on "The Constitution of Water." Papers, "Is Water an Electrolyte?" by Prof. P. Walden; "On the Nature of Molecular Association in the Special Case of Water," by Prof. P. Guye; "Liquid Water a Ternary Mixture. Solution-Volumes in Aqueous Solutions," by Mr. W. R. Bousfield and Dr. T. M. Lowry; and communications from Mr. W. Sutherland and Prof. W. Nernst ("The Specific Heat of Gaseous, Solid and Fluid Water").

Institution of Electrical Engineers (Birmingham Section).—Wednesday, April 27th. At 7.30 p.m. At the University, Birmingham. Paper on "Magnetic Oscillations Occurring in D.C. Machines," by Mr. G. W. Worrall.

Institution of Electrical Engineers (London).—Thursday, April 28th. At 8 p.m. At the Institution of Civil Engineers. Paper on "Earthed *v.* Insulated Neutrals in Colliery Installations," by Mr. W. W. Wood.

Institution of Civil Engineers.—Friday, April 29th. Students' visit to Southampton Docks and Messrs. Harland & Wolff's engineering shops.

THE ELECTRICAL ENGINEERS
(LONDON DIVISION).

THE following orders are announced:—

Commanding Officer—COL. R. E. B. CROMPTON, C.B.

Monday, April 25th.—"A" Company. Recruits' infantry drill, 6 to 6.45 p.m. company drill 7 to 9.30 p.m.
Tuesday, April 26th.—"B" Company. Infantry drill, 7 to 8 p.m.; technical drill, 8 to 10 p.m.
Wednesday, April 27th.—Gymnasium, 6 to 9.30 p.m.
Thursday, April 28th.—"C" Company. Recruits' infantry drill, 6 to 6.45 p.m.; company drill 7 to 8 p.m.; technical drill, 8 to 9.30 p.m.
Friday, April 29th.—"D" Company. Company drill, 7.15 to 8.30 p.m.; technical drill, 8.45 to 9.45 p.m.
Saturday, April 30th.—"C" Company. Company drill, 3 to 4.30 p.m. "A" Company. Company drill, 3.30 to 5 p.m.

(Signed) P. H. CAMPBELL, Capt. R.E., Adjutant.
For O.C. E.E., L.D.

NOTES.

A Discussion on Free Trade and Protection.—At the request of several of its members, the National Electrical Manufacturers' Association (Inc.) has convened a meeting to be held at the Caxton Hall, Westminster, on Monday, May 23rd, at 8 p.m., expressly for the purpose of a discussion on the effect of Free Trade or Protection upon the Electrical Industry. The discussion will be opened by Mr. Hugo Hirst (from the "Protection" point of view) and Mr. J. E. Kingsbury (from the "Free Trade" point of view). The chair will be taken by Mr. H. W. Butler, of the Electric Power Storage Co., the chairman of the Association. No resolution will be placed before the meeting, and no vote will be taken. Only those who are directly connected with the electrical industry will be allowed to take part in the discussion. Any person desiring to take part in the discussion is requested to send his name to the secretary, Mr. F. B. O. Hawes, at Balfour House, Finsbury Pavement, E.C., before May 21st next. The Association, will, as such, be in no way responsible for the views held by either of the openers of the discussion or the opinions expressed by its members individually or by others at the meeting.

Appointments Vacant.—Inspector of telephones for Government of Ceylon (£200); general assistant for the Bexley Council tramways (35s. to 40s.). See advertisement pages to-day.

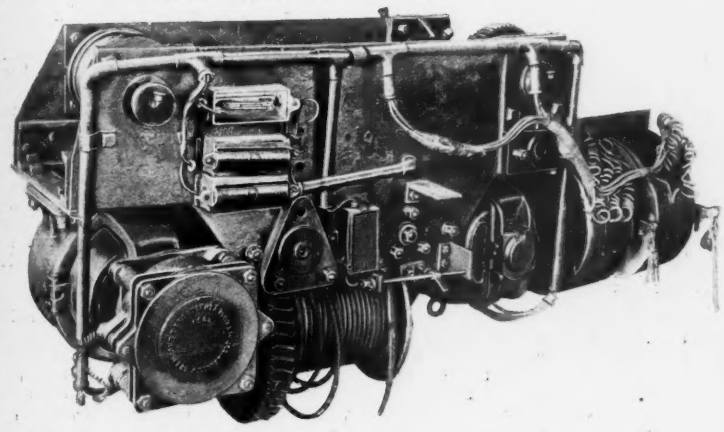
Motor-Starting Switchgear.—As we are going to press, we have received a letter from Messrs. Electric Control, Ltd., 177, Reid Street, Bridgeton, Glasgow, regarding the description published in our last issue of the switchgear made by the Premier Electric Control, Ltd., London. In the notice referred to, we mentioned "the solenoid starting switch of this company," being under the impression that it was made by the Premier Electric Control, Ltd.; but this, we regret to say, was an error. We are informed that Electric Control, Ltd., are the sole licensees and manufacturers of the solenoid starter, and they say that they have no connection whatever with the Premier Electric Control, Ltd., London.

(*Continued on page* 655)

ELECTRICAL MACHINERY AND APPARATUS FOR USE IN MINES.

The Lancashire Dynamo and Motor Co., Ltd.

A recent air-compressor installation at Newton Pit, supplied by this company, consists of an electrically-driven Tilghman compressor, coupled to a motor of 360 H.P. Power is supplied from the Lancashire Power Co.'s 10,000-volt 50-period circuit, and transformed down in a sub-station in the colliery grounds to 2,000 volts. The compressor is of the three-crank two-stage type with

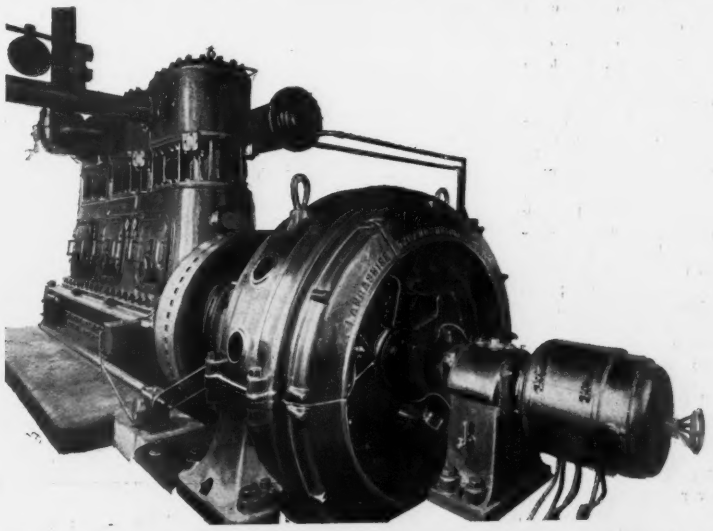


Lancashire Dynamo & Motor Co.'s Electrically-Driven Winch.

mechanically operated valves, and is capable of compressing 2,000 cb. ft. of air per minute to 75 lb. per square inch pressure. The starting torque is sufficient to start against full pressure, the rotor being of the wound type, and fitted with a short-circuiting device for the slip rings. The starter panel has a three-pole oil-break switch with no-volt and overload release trips fitted in two phases, and is enclosed in a sheet-iron case, with hinged doors interlocked with the oil switch, so that it can only be opened when the oil switch is in the "off" position.

The starter is of the liquid type and is provided with a hand wheel and screw gear for slow starting, the controller fingers making contact a with copper rod in the short-circuit position. The compressor is used down the mine for coal-cutting machines and drills, and also serves as a means of ventilation.

Another interesting mining apparatus recently built by the company is an electrically driven winch at the Astley Green Colliery of the Clifton and Kearsley Coal Co. The arrangement consists of a circular track with travelling crab, and was used for the purpose of setting cast-iron tubbing in a new pit shaft. The crab is of 2-ton capacity, and is carried by a circular track of 12 in. × 6 in. section, 32 ft. in diameter. The crab is fitted with two 1½-H.P. motors running at 460 R.P.M.—one for the hoisting motion, giving a speed of 5 ft. per minute with a load of 2 tons, and one for the travelling motion, giving a speed of 100 ft. per minute when fully loaded. The equipment also included the necessary electric brake over-winding arrangement, an angle-iron collector bar, and steel wire hoisting rope of sufficient length to give a lift of 12 ft. and an extension of 22 ft. when required. The barrel is specially set to allow for the hook being pulled outwards a distance of 3 ft. when necessary.



L. D. & M. Co.'s 360-H.P. Three-Phase Motor Driving Tilghman Air Compressor.

Lacy-Hulbert & Co., Ltd.

One of the most ingenious and simple of the smaller rotary pumps is the "Boreas," made by the above firm. It has only two mechanically operated parts and two bearings, and will raise almost any kind of liquid from reasonable depths, and force against any reasonable pressure. These pumps are constructed in six sizes, having capacities ranging from 10 to 1,000 gallons per hour, and weighing, without pulleys, from 1 lb. to 48 lb.

A special portable Boreas pump, mounted on wheels, is also supplied, direct coupled, to either an electric or a petrol motor.

Aluminium Bus-Bars.

An interesting illustrated list has been received from the British Aluminium Co., Ltd., wherein the firm describe their methods of jointing aluminium bus-bars, machine and feeder connections (round rod, flat bars and stranded conductors). Tabulated data as to sectional areas, microhms per ft., weight per ft. and dimensions of standard bus-bar sections are given.

Electricity Applied to Light and Power.

Messrs. Drake & Gorham, Ltd., of 66, Victoria Street, London, S.W., as most of our readers at home are aware, have made a very special study of the applications of electricity for country house and estate requirements for many years. In the course of their specialised experience in this direction, it has naturally followed that all sorts of queries have been raised by clients and intending users of electricity, and by careful tabulation of such queries and the answers given thereto the firm are in a position to know just what kind of information is required. The material contained in the new 130-page book which they have just issued under the above title is intended to meet such cases. A great deal of general information is given in the opening pages concerning such matters as points in favour of electric lighting, how electric light is produced, wiring and general treatment of rooms, initial outlay and cost of maintenance, water supply, electrically-driven farm and dairy machinery, electricity for refrigerating and ice-making machinery, electricity in the laundry, electric lifts, generating plant (water, wind, gas and steam), village lighting stations, motor cars, and so forth. The main manufactures required in connection with such installations are briefly alluded to and illustrated, and there are some fine photographs of interiors electrically illuminated, and exteriors of beautiful mansions wherein "D. & G." installations have been put down. An imposing list of installations carried out by the firm, and of testimonials received, occupies many pages. Messrs. Drake & Gorham have published a certain number of copies of the above book at 1s. 6d., but they have placed a few copies at our disposal for gratis distribution among those specially interested.

Electric Hoisting.

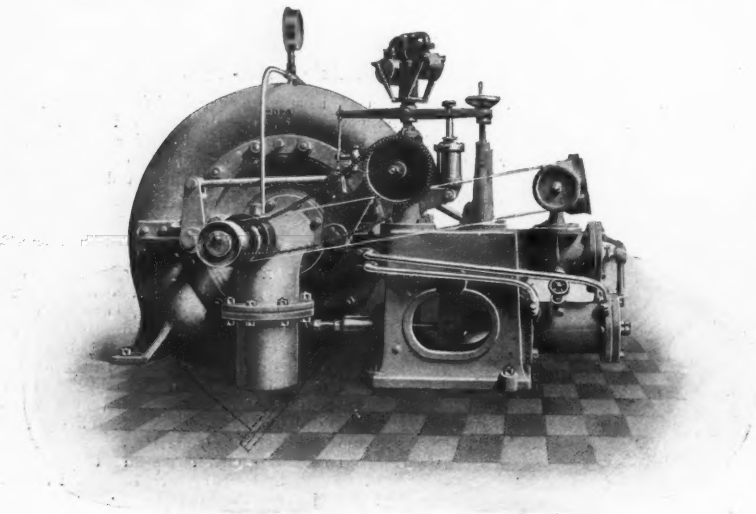
From the Maschinenfabrik Augsburg-Nurnberg A.G. London office we have received some pamphlets illustrating their cranes for iron and steel works and rolling mills, also cranes fitted with M.A.N. double-drive, such as they have supplied to the leading Continental engineering works.

F

Gilbert Gilkes & Co., Ltd.

The accompanying particulars of a turbine supplied by this well-known firm to the French Bobs Mine, South Africa, through Messrs. Hubert Davies & Co., will be of interest to mining readers.

The turbine, which is illustrated herewith, is of the inward-flow type, known as the double vortex. It is designed to develop



Gilkes 70-h.p. Turbine and Relay Governor.

70 b.h.p. with an effective fall of 180 ft., using 274 cb. ft. of water per minute, and running at 1,000 r.p.m. It will be seen from the illustration that the outside casing is of the spiral form, in order that the water may have a uniform velocity inside the case. The water is directed on to the wheel by means of short movable guides of the "Francis" type, which ensure a very high efficiency on all loads. These guides are made of gun-metal, and are actuated by means of a gun-metal ring, which, in turn, is operated by the cranks seen in the illustration, which receive motion from the governor cylinder. The revolving wheel is of brass, and has a dividing plate, so that half the water is discharged on each side and passes out through the suction bends. These bends are connected to a draught tube common to the two by means of a breeches pipe, about 18 ft. of the fall being utilised by means of suction. With the double discharge, all end thrust on the shaft is eliminated, there being no necessity for the thrust bearing which is always fitted to turbines with single discharge. In addition to the stuffing boxes on the suction bends, water-seal back bushes are fitted, connected by small copper pipes with the pressure in the turbine case; this makes it impossible for air to be drawn into the suction tubes. The turbine shaft is supported in a ring-oiling bearing, a flexible coupling being used for coupling to the dynamo which it drives.

Speed regulation is effected by means of a governor of the hydraulic relay compensating type, which, while allowing the turbine gate to be moved over its full range from shut to open in as small a period of time as four seconds, at the same time entirely prevents hunting when running on the lightest loads. Its general action will be gathered from the illustration. The centrifugal portion of the governor is of the high-speed spring-loaded type, driven by means of a Renolds silent chain from an extension of the turbine shaft. When a portion of the load is thrown off, a slight rise in speed on the turbine causes the governor balls, through the medium of the governor levers, to depress the distributing valve, causing high-pressure water to pass to one end of a hydraulic cylinder, and at the same time opening the other end of the cylinder to exhaust. By this means the hydraulic piston is caused to move, and being connected by means of a rocking shaft and levers to the turbine gate, causes the gate to close slightly. A filter is provided to extract from the water any foreign matter that might cause the governor valve to stick. A special feature of this filter is that by a very simple movement the whole of the filter may be cleaned out in a few seconds whilst the plant is running. The rotating parts of the governor are all automatically lubricated, and this enables the plant to be left running for very considerable periods of time without any attention.

The turbine was coupled direct to a three-phase alternator, made by the Electric Construction Co., Ltd., of Wolverhampton, giving 45 kw. at 1,000 r.p.m., 50 cycles, 500-550 volts, with a power factor of 0·8.

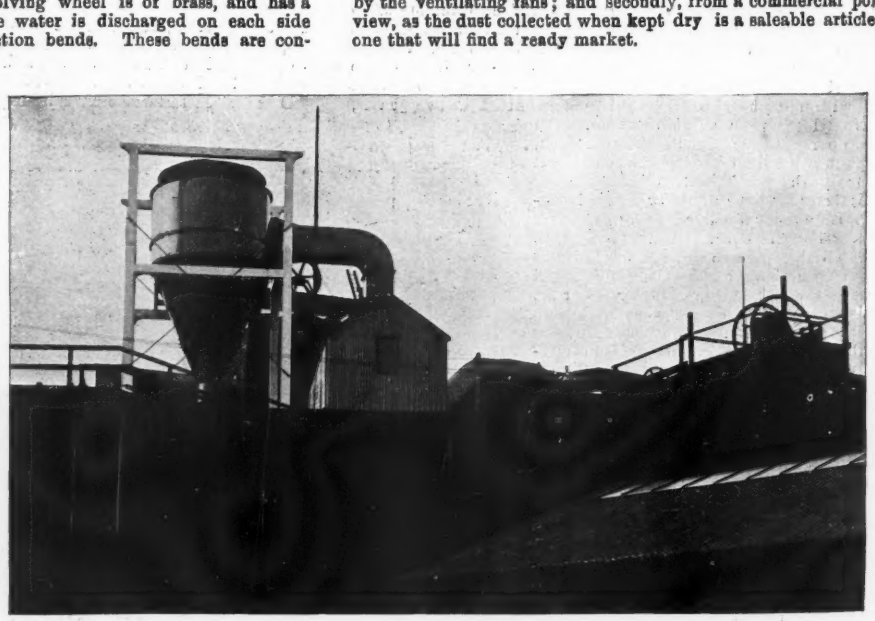
Matthews & Yates, Ltd.

The danger of coal dust in mines is a question which has been engaging the attention of mining experts for some considerable time, and it is now generally acknowledged that when allowed to accumulate in the workings, it becomes a serious menace to the safety of the mine, on account of its extreme liability to explode. In fact, it is held that several recent colliery explosions have been due to this cause.

The dust, being generated at so many points, is a difficult matter to handle down the mine, but on the surface it is another matter. The screens and tipplers are undoubtedly responsible for creating a large proportion of the dust, and owing to their close proximity to the pit mouth, this dust is drawn into the workings by the action of the ventilating fans. To overcome this difficulty the Cyclone dust collecting plant has lately been introduced by Messrs. Matthews and Yates, Ltd., who claim to have installed the first plant for this purpose.

The plant consists of a Cyclone exhauster (electrically driven or otherwise) and a battery of the firm's lately patented Cyclone separators, which may be fixed in any convenient position. The suction side of the fan is then connected with the screens, &c., by means of hoppers, hoods and trunking, through which the fans draw the dust-laden air, delivering it into the separators, where, by centrifugal action, the dust is caused to fall into suitable receptacles, while the air escapes at the top.

The advantages of such a plant are twofold: first, in preventing the coal dust from being drawn down the shaft into the workings by the ventilating fans; and secondly, from a commercial point of view, as the dust collected when kept dry is a saleable article, and one that will find a ready market.



"Cyclone" Dust-Collecting Plant at a Colliery.

The Cyclone blower and exhauster is also highly suitable for mine ventilation, not only as the main ventilator, usually on the pit brow, but also when, coupled to the firm's own motors, it is used as an auxiliary to the main fan, for supplying ventilation to remote workings which do not come within the scope of the ordinary ventilation. The accompanying illustration shows a Cyclone dust-collecting plant installed by Messrs. Matthews & Yates, Ltd., who have had a great amount of experience in all kinds of ventilation.

Siemens Battery Lamps.—Messrs. Krupka & Jacoby, 11, Queen Victoria Street, E.C., inform us that they are now in a position to supply 4 and 8-volt battery lamps with drawn tungsten filaments, taking 1 watt per c.p., and giving 4 and 8 c.p. respectively.

The British Insulated and Helsby Cables, Ltd.

Amongst the various mining apparatus which this company supply may be specially mentioned their magneto-mining tele-

Fig. 1.—B.I. & H.C. Magneto Mining Telephone.

phone (fig. 1), in which the fittings, enclosed in a substantial gas and water-tight cast-iron case, comprise a five-magnet generator to ring 30 1,000-ohm bells in parallel, with a line resistance of 1,000 ohms, and a magnetic bell of special design in a water-tight case, of 1,000 ohms resistance, with two magnets. Two P.O. pattern double-pole bell receivers and a solid-back transmitter are supplied, and a P.O. pattern induction coil with screw connections.

For use with either magneto or battery ringing instruments for a few lines, the company supply a very useful and efficient wall-pattern board, which we illustrate in figs. 2 and 3, showing the front and rear views respectively. The operator's instrument is connected with one side to an inner spring of each jack, and the other to the shutter of all the indicators.

The service plug is also connected across the instrument. A two-way and a three-way plug are used to make up a connecting unit; when two lines are joined, the indicator of the line to which the three-way plug has been connected is cut out of circuit, and the other line indicator remains as the ring-off signal.

This apparatus is very compactly constructed, there being only one jack and one indicator per line, and no ring-off indicators.

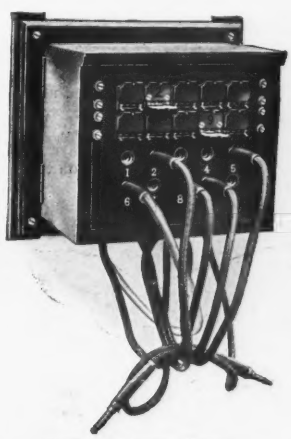


Fig. 2.—Front View.

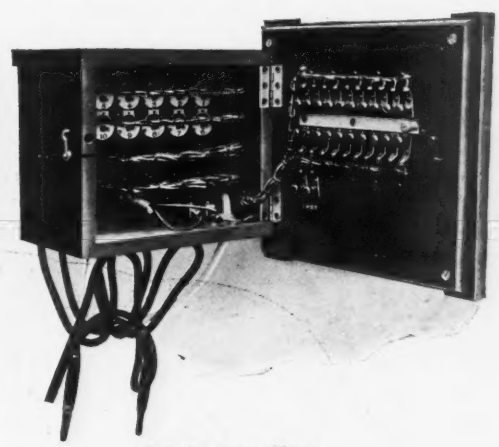


Fig. 3.—Back View.

B.I. & H.C. 10-line Switchboard.

Some New Zealand Mining Pumps.

According to our contemporary, the *Electrical Review and Western Electrician*, electric pumps have been installed at the Crown mines, Karangahake, N.Z., to raise water some 380 ft., a distance which will be increased later to 750 ft., when further sinking is carried out.

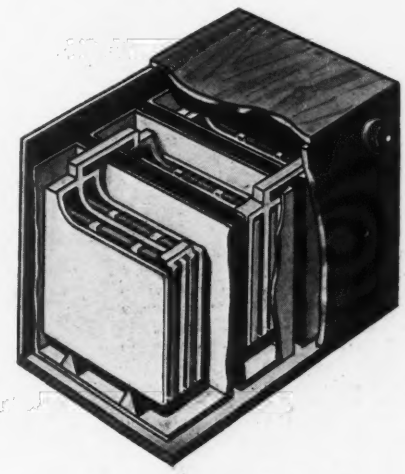
Two Worthington double-acting duplex ram pumps are in use, driven by 250 B.H.P. induction motors through double-reduction gearing; energy is obtained from a local hydro-electric plant and transmitted in the mine by armoured paper-covered three-core cables.

Power Presses.

Mr. L. Schuler (Göppingen, Wurttemberg), of 138, Southwark Street, London, S.E., has just published a couple of catalogues (well got up and finely illustrated) showing and describing (1) single and double-acting power presses, dial-feed presses, and reducing presses; (2) fly-screw presses, double pillow, and arch and power-screw presses, for sheet-metal working.

The Premier Accumulator Co., Ltd.

The accompanying illustration shows the construction of the special type of portable battery supplied by the Premier Accumulator Co. for lighting and ignition work in colliery installations. The plates employed for this work are specially designed to stand the roughest handling and ill-treatment; they are of the Planté



Premier Portable Battery.

type, and are permanently coupled up as shown. The cells are contained in lead-lined wooden boxes, completely covered in, and are carried by means of a strap handle. The terminals are fixed on the outside of the box. The cells are so constructed that they require the minimum of attention, and it will be seen that simplicity is the keynote of the design.

Ruston, Proctor & Co., Ltd.

The "Recke-Ruston positive gear" steam engines made by Messrs. Ruston, Proctor & Co. are characterised by a special system of valve gearing, of the rolling-lift type, which ensures the opening and closing of the valves without shock, and enables the engines to run smoothly at higher speeds than usual, under the control of a shaft governor. They are of the horizontal type, either single cylinder, or tandem or coupled compound, and are well adapted for coupling to electric generators. Messrs. Ruston, Proctor & Co., Ltd., also make the "Ruston" gas engines and suction-gas producers, with special designs for electric lighting and power purposes, up to 260 B.H.P.

W. Sisson & Co., Ltd.

For the "Sisson" patent enclosed engine, which has been largely used for electric lighting and power at collieries, gold mines, textile factories, &c., both at home and abroad, a remarkably low consumption of oil is claimed; a 100-KW. set at a colliery, running 20 hours a day, in six months cost for oil only £3 4s. 6d. Another engine, developing 600 H.P. at 200 R.P.M. at a South African mine, ran for eight months without a stop, except about one hour a week for inspection and replenishment of oil. Other high qualities claimed for it are economy of fuel and close governing, the valve gear being of the firm's own patent automatic expansion type with shaft governor.

The British Electric Plant Co., Ltd.

The development of the turbine pump, inspired, perhaps, by that of the steam turbine, which has elbowed its way to the front rank during the last quarter century only with extreme difficulty and patience, has brought about a similar revolution in its own domain. The simplicity of its predecessor, the centrifugal pump, assisted

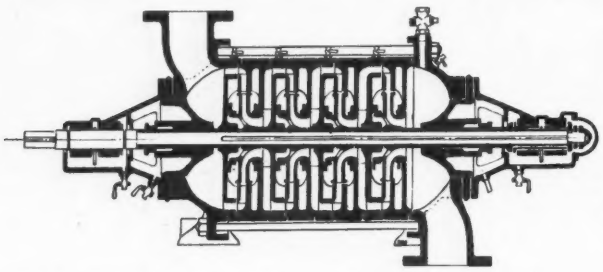


Fig. 1.—Section of British Electric Plant Co.'s Turbine Pump.

the latter to hold its own, but modern improvements in design have largely nullified this advantage and enabled the turbine pump to score a victory.

The type of turbine pump made by the British Electric Plant Co., Ltd., has been developed in the main along what may be regarded as standard lines; it consists of one or more impellers revolving in a suitable chamber, a guide or diffusion plate being used to reduce the velocity of the water at its discharge

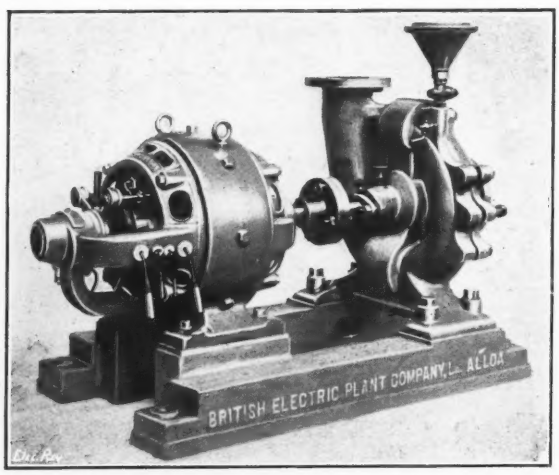


Fig. 2.—B.E.P. Single-Stage Turbine Pump.

from the periphery of the impeller. Thus far the design follows the usual practice, but in the embodiment of the principle of generating pressure by the transformation of velocity energy, several very interesting and important deviations are noticeable, chief among which is the patented system of balancing employed. An important feature of the system is the entire absence of mechanical means for meeting the great difficulty of axial thrust

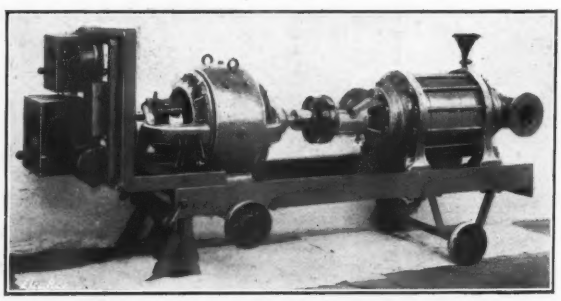


Fig. 3.—B.E.P. Special Pumping Set.

which has in the past been a fruitful subject for the ingenuity of the manufacturer.

The method by which this result is attained is the acme of simplicity, as will be at once apparent on a glance at its component parts (fig. 1). The absence of ball or thrust bearings or balance pistons, as usually fitted, is very noticeable, their place being taken by simple collars, which serve the purpose of controlling the end play of the shaft, to keep the impellers exactly opposite their respectiv ports on the diffusion plates.

The arrangement of the waterways in the castings is also worthy of note, as they are so arranged that the entire path of the water is in view for inspection. This is accomplished by making all castings, with the exception of the impeller, open—*i.e.*, they have no cored passages, and, consequently, all channels are exposed on disassembling the pump. The simplicity of the castings is striking, and should appeal to engineers who have to deal with the repair and upkeep of machinery underground.

The bearing surfaces are especially long, thus ensuring a maximum volumetric efficiency by reducing to a negligible quantity leakage between volumes of water which are at widely differing pressures.

Special attention has been directed to the making of vulnerable parts renewable, and it is possib'e to fit spare parts which will practically renew the life of the pump an indefinite number of times, or, at least, as long as the chamber castings are in a fit state to continue in service, corrosion often so reducing them in thickness that they are unable to withstand the working pressure. These renewals comprise, as a rule, the following parts, some of them, of course, being more susceptible to wear than others:—

Impellers, diffusion plates, impeller neck rings, shaft sleeves (which act as distance pieces between the impellers and serve to protect the shaft from corrosion and from wear in bearings, no part of the shaft whatever being exposed to the water or being in immediate contact with supporting bearings), internal shaft bearing bushes and also the main bearing bushes at each end of the pump.

A single-stage pump is also made by the company on similar lines. One of these is shown in fig. 2, the capacity being 230 G.P.M. against a total head of 35 ft., running at a speed of 1,140 R.P.M. The pump is a 5-in. single stage, the internal parts being of cast-iron, and the motor is one of the company's standard inter-pole type of 5-B.H.P. capacity. This set came out exceedingly well on test, the efficiency of the pump being 72 per cent., a very satisfactory figure for such a small pump. A high efficiency is maintained even in the smallest size of pump, and the makers can reach 70 per cent. with 100 G.P.M. This set was supplied to Messrs. Wilsons & Clyde Coal Co, Killernie Colliery, Fifeshire.

Fig. 3 illustrates a special pumping set used for dook work, arranged on a trolley so that the pump may follow the water down as the dook is emptied. This set was arranged to deliver a constant quantity of 400 G.P.M., against a head rising from 0 to 200 ft. A special point about the operation of the set is that the quantity must not exceed 400 G.P.M. even at the lowest head; to enable this to be done economically, the motor is capable of considerable speed variation, and the pump is so arranged that either one, two or three impellers may be used, depending on the head against which the pump is to work. By using such a system, considerable economy is effected in the energy required to do a certain amount of work, and the operation of fitting an extra impeller is a very simple matter, occupying only an hour or so. The trolley also carries all the necessary switchgear, so that the complete apparatus is easily controlled by the attendant. This set was supplied to the United Collieries, Ltd., for their Kirkwood Colliery.

The Foster Arc Lamp and Engineering Co., Ltd.

The accompanying illustration shows a portable Foster transformer, which has a capacity of 15 KW. but can easily be handled by one man; it is provided with variable primary and secondary windings, and is specially intended for temporary or breakdown work, such as connecting low-voltage motors or lighting circuits to a

Foster "Q" Flame Arc Lamp and Portable Transformer.

high-voltage supply. Another figure shows the Foster flame arc lamp, their new Q type, which burns for 40 or 50 hours with one trimming; we gave a description in our issue of January 7th of this lamp, which costs only 0·18d. per hour for carbons, giving a light of 3,500 C.P. with 500 watts. It is intended for outdoor lighting, and should be very suitable for use above-ground on mining installations.

Electric Capstans.

The electrically-driven capstan is now finding an extended application at collieries and other places where shunting work is necessary. We illustrate herewith the capstans manufactured by Messrs. Hillairet Huguet, of Paris, and sold by the Union Electric Co., Ltd., as possessing points which uniquely fit them for their class of work. They are self-contained, efficient, reliable, entirely weather-proof and of very substantial design, the designers having aimed at producing a piece of apparatus which will work steadily, without incurring delays from breakdowns, or heavy maintenance costs. Moreover, their operation is so simple that even an inexperienced lad can work a capstan quite satisfactorily.

For use on D.C. circuits, a capstan having the drum and motor armature mounted on the same shaft is supplied. On A.C. circuits, or on D.C. circuits where lower initial cost is desirable, capstans are provided with spur gear between the drum and the vertical motor shaft. In all patterns the motor and starting switch are contained in a heavy cast-iron case having no joints below the ground level, so as to prevent damp or rain from reaching the electrical parts. The capstans are provided with means for inspecting the motor with great ease, both in the geared and in the gearless type.

The radical points of difference between these capstans and others lie in the motors. These are so designed that all starting resistances are dispensed with, the starting being effected by a simple double or triple-pole switch. The winding of the motor is such that the starting current never exceeds that necessary to exert the maximum torque the capstan is designed to give. Consequently to start the capstan all that is necessary is to press the pedal which operates the starting switch, and the capstan is at once put into action. As the load gets under way the speed increases, the torque decreases and the current is also reduced in proportion; that is to say, the current taken is at all times the minimum value necessary to obtain the required torque.

Capstans can be supplied either for direct-current or single, two or three-phase alternating current. In the direct-current types the starting switch is provided with a magnetic blow-out coil; the alternating switches are provided with carbon sparking tips. Thanks to the gradual acceleration of the load, only a small number of turns of the rope need be put round the drum, so that easier handling and quicker manipulation are obtained. For the same reason, when the load is being started, instead of having to let the rope slip on the drum it can be pulled tight, causing the load to get under way more speedily.

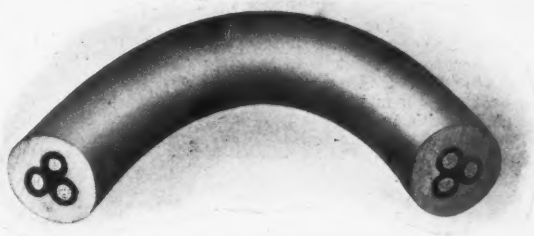
Geared Capstan (Union Electric Co., Ltd.).

We are informed that over 800 of these capstans have been made and supplied, quite a large proportion of them to mines on the Continent. One of the largest direct-acting capstans has recently been installed on the system of the Great Northern Railway of Ireland, and two of the A.C. type are at work in a coal yard in Ireland.

The St. Helens Cable and Rubber Co., Ltd.

The question what type of cable to employ in mines is one which has exercised the brains of electrical engineers ever since electricity was first introduced below ground, for the conditions to be complied with there are almost unique in difficulty and severity. The constant presence of corrosive moisture and warmth, the liability to breakage by falls of roof, and the rough handling to which the cables are subjected, call for the toughest and most durable insulation and mechanical protection, while the possible consequences of a leak or break, in the shape of fatal shock or explosion, intensify the anxieties of those responsible for the upkeep of the installation. The St. Helens Cable Co., having their domicile in the midst of a coal-mining district, naturally had their attention directed to the matter from the earliest days, and specialised in cables for collieries. For this class of work their well-known Dialite cables are largely used, as they are insulated with Dialite vulcanised bitumen, a substance which is practically imperishable and proof against moisture laden with mineral matter. The company have also given much attention to the best methods of installing electric cables in mines, and of securing safety for the men who handle them.

One of the weakest points in the electrical chain is the trailer cable used for connecting coal-cutters to the gate-end box, which is constantly exposed to wear and to accidental damage, while, as it is continually handled by the men, any defect in the insulation may easily have fatal consequences. To overcome the difficulties of this problem, the St. Helens Cable Co. have recently put on the market a special flexible trailing cable, a section of which is illustrated herewith.



St. Helens Special Trailer Cable.

Each conductor of the single, twin or three-core cable is insulated in the usual way with pure and vulcanised rubber and taped. These cores are then twisted together, and completely padded and sheathed overall with the company's special cab tire compound. This material is made up in the same manner as their solid rubber tires for cabs and cars, &c.; having been large manufacturers of these for many years, they are in a position to know, from practical experience, the best compounded rubber for resisting wear on flinty roads, &c., and it occurred to them that a sheathing of this material would form an excellent protection for coal-cutter cables, a conclusion which has been borne out in practice. The initial cost is rather higher than that of the ordinary type of trailer cables, but we are informed that the special cable outlasts two, and sometimes even three, of the old type.

Gearless Type of Capstan.

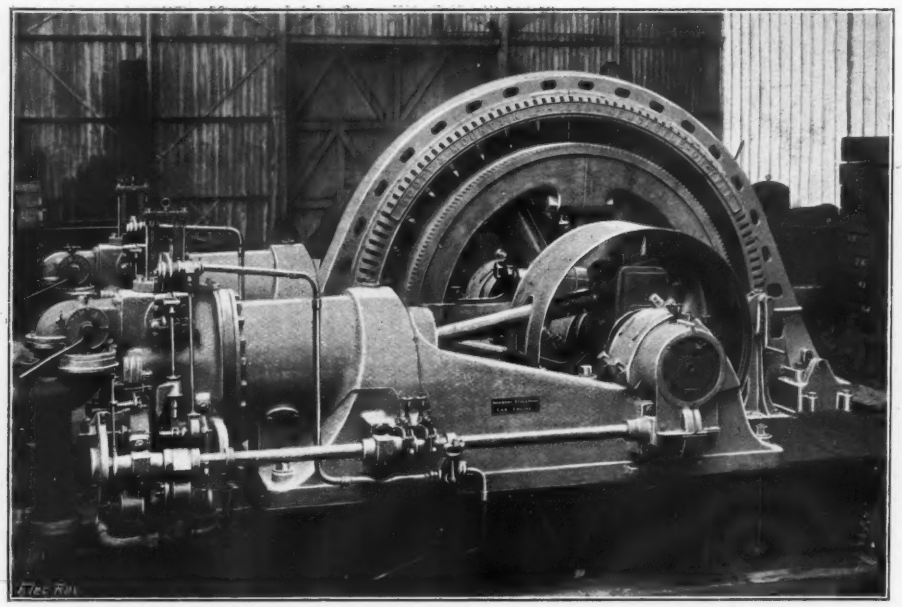
R. Wolf.

Where coal is dear but steam power is necessary, as at mines remote from the seaboard, an economical prime mover is the Wolf patent superheated steam "Locomobile," which comprises in small compass a combined boiler, superheater and engine, occupying the minimum of floor space and requiring only light foundations. In these machines the engine is mounted on the top of the boiler, and the superheater is placed in the smoke box. The furnace is of cylindrical shape, and can be withdrawn bodily with the tubes, the furnace and tubes being built up between two plates which are bolted up steam and watertight to the boiler shell. The superheating coil can also be readily removed. Balanced piston valves are used, with a shaft governor, and automatic lubrication is provided.

A large number of these Locomobiles has been supplied for powers up to 600 H.P., not only for such work as is mentioned above, but also for permanent installation in electricity works, factories, mines, &c.; owing to their construction, they can be transported in parts over great distances into mountainous regions and other places difficult of access. A test conducted by Messrs. Burstall and Monkhouse last year on a 150-H.P. Wolf tandem compound condensing Locomobile, with superheater, showed a consumption of 1·05 lb. of coal, and 8·81 lb. of water per B.H.P.-hour at full load; but we are informed by the makers that they have recently obtained a consumption of 0·78 lb. coal, and 7·6 lb. steam per B.H.P.-hour.

Ernest Scott & Mountain, Ltd.

The Caledonian Coal Co. (Australia) are about to increase the electrical installation at their Aberdare Collieries, near Melbourne, and in this connection Messrs. Ernest Scott & Mountain, Ltd., have recently shipped machinery for the full equipment of these collieries. This last consignment of machinery is partly the duplicate of plant dispatched by the same firm some 12 months ago. The original generating set consisted of a 250-kw. alternator driven by a steam engine, with numerous motors in connection therewith. As two of the mines of the Caledonian Coal Co. are at a considerable distance from the power station, it has been decided to put in high-tension plant and to transmit power to two sub-stations. For this purpose Messrs. Ernest Scott & Mountain have recently delivered a combined set, consisting of a 375-b.h.p. two-crank central-valve engine, working non-condensing, at 428 r.p.m.; a 250-b.h.p. 2,200-volt 50-cycle alternator with a direct-coupled exciter; a motor-generator of 300 h.p.; one 100-kw. generator set, with the same type of motor as above mentioned, along with exciter,



Scott & Mountain 326-k.v.a. Three-Phase Alternator and Hornsby-Stockport Gas Engine.

to run at 428 r.p.m.; and three motor-generators, each of 150 h.p., 410 r.p.m., 2,100 volts, together with the necessary switch-gear, &c.

In addition to the foregoing, the firm have just delivered, for installation at a colliery power station near Melbourne, a 326-k.v.a. 550-volt three-phase crank-shaft generator running at 166 r.p.m. The diameter of the rotor is 132 in., and the width 5 in., and there are 36 poles. This generator is driven by a Hornsby-Stockport gas engine of 400 h.p. The set, illustrated above, will run in parallel with a 280-k.v.a. 550-volt three-phase alternator, 428 r.p.m., driven by a three-crank steam engine.

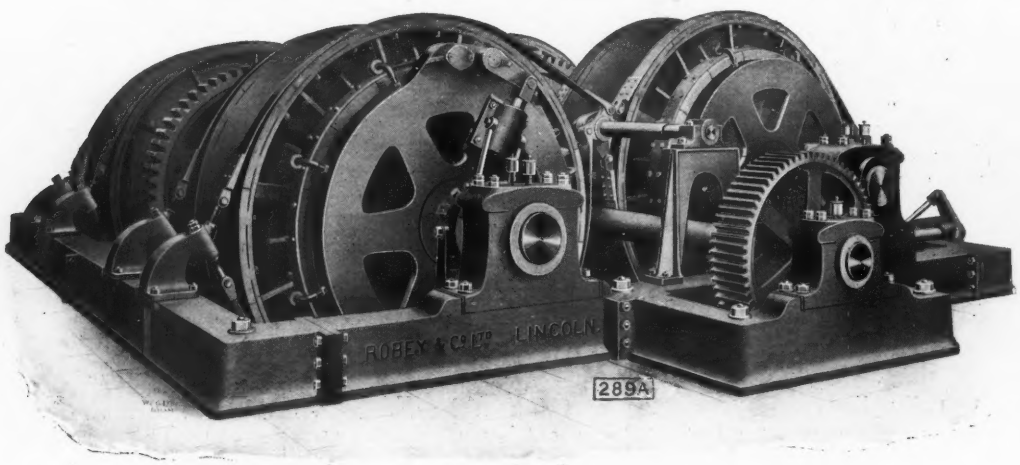
Robey & Co., Ltd.

Messrs. Robey & Co. have sent us particulars of the large haulage gear shown in the accompanying illustration. This is a double main-and-tail electric haulage gear, and consists in effect of two separate haulage gears, each driven by its own motor; both gears are mounted on a common bedplate, and are connected through a jaw clutch on the second-motion shafts, so that either gear, in the event of breakdown of its own motor, could be driven by the other motor.

The normal rated output of each motor was 200 h.p., but they had to be capable of withstanding an overload of 100 per cent. for short periods. The four drums were each 6 ft. in diameter, the two main drums being 2 ft. 3 in. wide, and the two tail drums being 2 ft. 6 in. wide. Each main drum was placed behind its tail drum and raised above it, so that its rope could clear the tail drum when full of rope. The rope speed was 10 miles per hour. The drive was transmitted from the motor to the drum shafts through double-reduction spur gearing, and thence to the drums, which were loose on the shafts, by means of massive friction clutches of the Hall type, which were operated from the driver's platform through screw gear. Strap brakes were provided as shown, being controlled by the driver through pedals and levers.

Crompton & Co., Ltd.

The first figure on the opposite page shows a heavy double-reduction single-drum haulage of the self-contained type designed for a normal horse-power of 350, with the motor running at 450 r.p.m., supplied to a Welsh colliery by Messrs. Crompton & Co., Ltd. The gearing is arranged to give a mean rope speed at the drum of 6 miles per hour. It is entirely of steel, the first motion being machine cut.



Robey Double Main-and-Tail Electric Haulage Gear, 2 × 200 h.p.

There is one drum, 5 ft. × 2 ft. 3 in. × 1 ft. 3 in., which is bushed with gun-metal, and runs loose on the shaft, being driven by means of a steel jaw clutch of large diameter. The drum is strongly constructed on a cast-iron centre with steel plate sides, each strengthened with a cast-iron brake ring. The brake is of the double-pillar type worked by a foot lever.

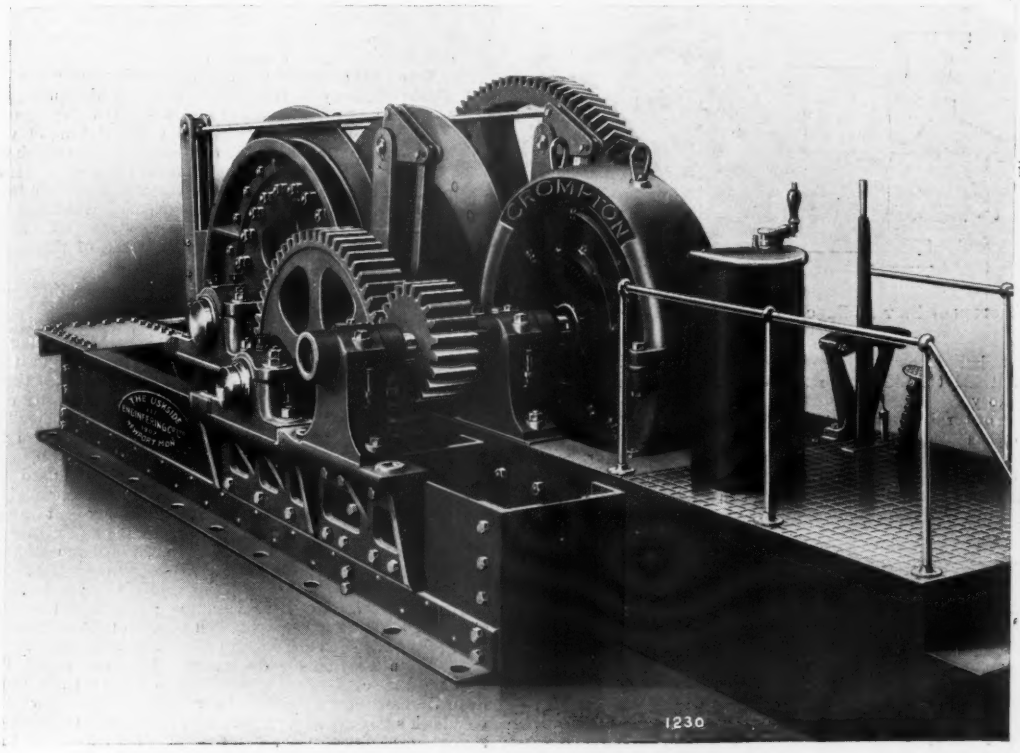
The bedplate is built up entirely of steel plates and angles. It is a very satisfactory job throughout, and special attention has been paid to ensure rigidity and minimise the vibration, which is the main fault of many large hauling gears. It is a type which is being adopted for the main hauling engines working a drift which

has a good gradient all the way, so that the empty trams will run down on the brake.

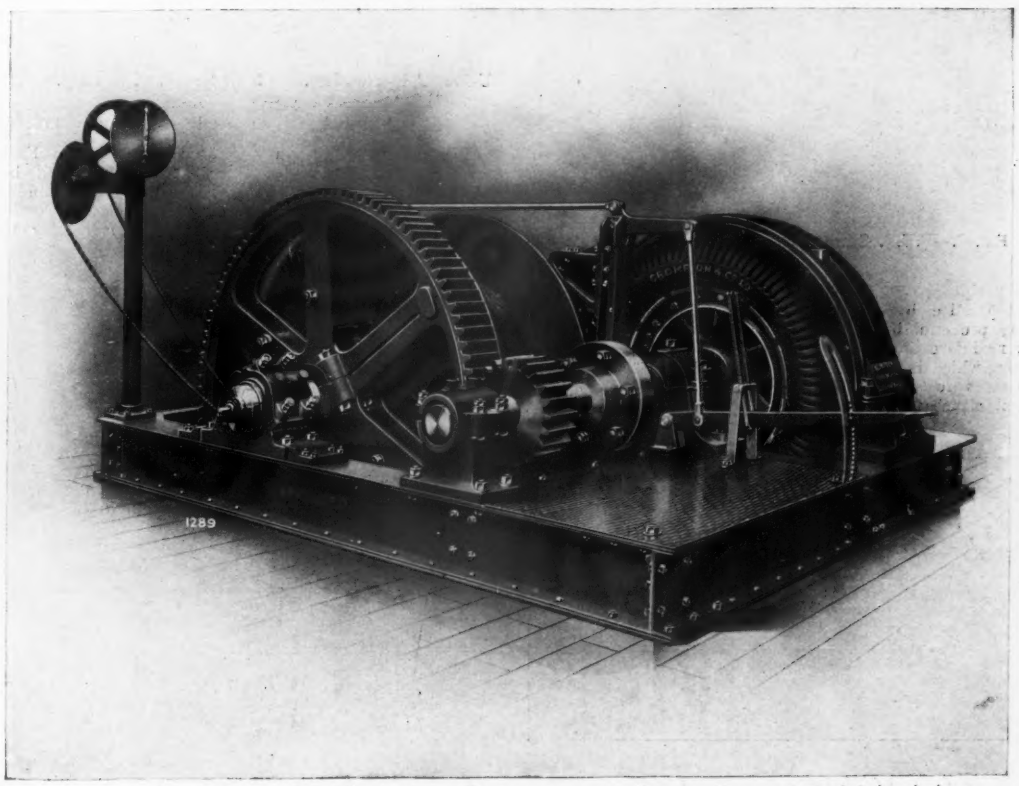
The mechanical part is by the Uskside Engineering Co., of Newport, Mon., and includes the bedplate underneath the motor.

In this case there is no flexible coupling, the motor shaft being rigidly coupled to the pinion shaft.

This is not so good a design as the former, and to make a good job there ought to be a bearing on each side of the coupling; no rigid couplings should be used with haulage motors, on account the extreme vibration set up by the haulage gears when hauling. In some cases, however, the rigid coupling must be put in on account of space being limited, and space underground is often a matter of great importance. The mechanical portion of this haulage gear is by Messrs. M. B. Wild & Co., of Birmingham.



Crompton 350-b.h.p. Electrically Driven Single-Drum Haulage Gear.



Crompton 150-b.h.p. Single-Drum Single-Reduction Haulage Gear.
Three-phase motor wound for 2,200 volts.

The cost of such a gear could be considerably reduced, if necessary, by using cast-iron main gearing and a lighter pattern of drum.

The second figure shows a single-drum single-reduction haulage gear driven by a 150-b.h.p. three-phase motor wound for 2,200 volts, and is one of two haulages supplied to another Welsh colliery.

G

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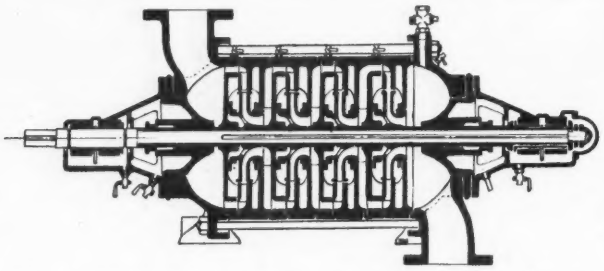

Fig. 1.—Section of British Electric Plant Co.'s Turbine Pump.

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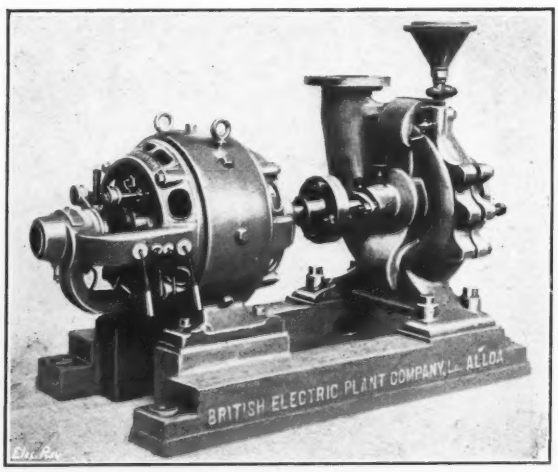

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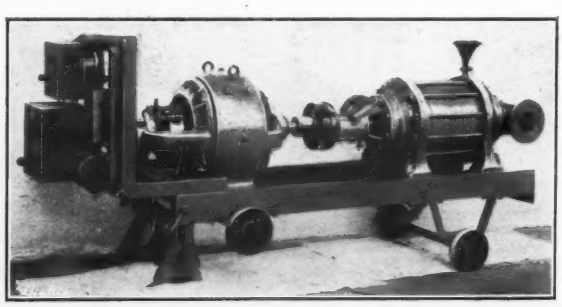

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The arrangement of the waterways in the castings is also worthy of note, as they are so arranged that the entire path of the water is in view for inspection. This is accomplished by making all castings, with the exception of the impeller, open—*i.e.*, they have no cored passages, and, consequently, all channels are exposed on disassembling the pump. The simplicity of the castings is striking, and should appeal to engineers who have to deal with the repair and upkeep of machinery underground.

The bearing surfaces are especially long, thus ensuring a maximum volumetric efficiency by reducing to a negligible quantity leakage between volumes of water which are at widely differing pressures.

Special attention has been directed to the making of vulnerable parts renewable, and it is possible to fit spare parts which will practically renew the life of the pump an indefinite number of times, or, at least, as long as the chamber castings are in a fit state to continue in service, corrosion often so reducing them in thickness that they are unable to withstand the working pressure. These renewals comprise, as a rule, the following parts, some of them, of course, being more susceptible to wear than others:—

Impellers, diffusion plates, impeller neck rings, shaft sleeves (which act as distance pieces between the impellers and serve to protect the shaft from corrosion and from wear in bearings, no part of the shaft whatever being exposed to the water or being in immediate contact with supporting bearings), internal shaft bearing bushes and also the main bearing bushes at each end of the pump.

A single-stage pump is also made by the company on similar lines. One of these is shown in fig. 2, the capacity being 230 G.P.M. against a total head of 35 ft., running at a speed of 1,140 R.P.M. The pump is a 5-in. single stage, the internal parts being of cast-iron, and the motor is one of the company's standard inter-pole type of 5-B.H.P. capacity. This set came out exceedingly well on test, the efficiency of the pump being 72 per cent., a very satisfactory figure for such a small pump. A high efficiency is maintained even in the smallest size of pump, and the makers can reach 70 per cent. with 100 G.P.M. This set was supplied to Messrs. Wilsons & Clyde Coal Co, Killernie Colliery, Fifeshire.

Fig. 3 illustrates a special pumping set used for dook work, arranged on a trolley so that the pump may follow the water down as the dook is emptied. This set was arranged to deliver a constant quantity of 400 G.P.M., against a head rising from 0 to 200 ft. A special point about the operation of the set is that the quantity must not exceed 400 G.P.M. even at the lowest head; to enable this to be done economically, the motor is capable of considerable speed variation, and the pump is so arranged that either one, two or three impellers may be used, depending on the head against which the pump is to work. By using such a system, considerable economy is effected in the energy required to do a certain amount of work, and the operation of fitting an extra impeller is a very simple matter, occupying only an hour or so. The trolley also carries all the necessary switchgear, so that the complete apparatus is easily controlled by the attendant. This set was supplied to the United Collieries, Ltd., for their Kirkwood Colliery.

The Foster Arc Lamp and Engineering Co., Ltd.

The accompanying illustration shows a portable Foster transformer, which has a capacity of 15 KW. but can easily be handled by one man; it is provided with variable primary and secondary windings, and is specially intended for temporary or breakdown work, such as connecting low-voltage motors or lighting circuits to a

Foster "Q" Flame Arc Lamp and Portable Transformer.

high-voltage supply. Another figure shows the Foster flame arc lamp, their new Q type, which burns for 40 or 50 hours with one trimming; we gave a description in our issue of January 7th of this lamp, which costs only 0·18d. per hour for carbons, giving a light of 3,500 C.P. with 500 watts. It is intended for outdoor lighting, and should be very suitable for use above-ground on mining installations.

Electric Capstans.

The electrically-driven capstan is now finding an extended application at collieries and other places where shunting work is necessary. We illustrate herewith the capstans manufactured by Messrs. Hillairet Huguet, of Paris, and sold by the Union Electric Co., Ltd., as possessing points which uniquely fit them for their class of work. They are self-contained, efficient, reliable, entirely weather-proof and of very substantial design, the designers having aimed at producing a piece of apparatus which will work steadily, without incurring delays from breakdowns, or heavy maintenance costs. Moreover, their operation is so simple that even an inexperienced lad can work a capstan quite satisfactorily.

For use on D.C. circuits, a capstan having the drum and motor armature mounted on the same shaft is supplied. On A.C. circuits, or on D.C. circuits where lower initial cost is desirable, capstans are provided with spur gear between the drum and the vertical motor shaft. In all patterns the motor and starting switch are contained in a heavy cast-iron case having no joints below the ground level, so as to prevent damp or rain from reaching the electrical parts. The capstans are provided with means for inspecting the motor with great ease, both in the geared and in the gearless type.

The radical points of difference between these capstans and others lie in the motors. These are so designed that all starting resistances are dispensed with, the starting being effected by a simple double or triple-pole switch. The winding of the motor is such that the starting current never exceeds that necessary to exert the maximum torque the capstan is designed to give. Consequently to start the capstan all that is necessary is to press the pedal which operates the starting switch, and the capstan is at once put into action. As the load gets under way the speed increases, the torque decreases and the current is also reduced in proportion; that is to say, the current taken is at all times the minimum value necessary to obtain the required torque.

Capstans can be supplied either for direct-current or single, two or three-phase alternating current. In the direct-current types the starting switch is provided with a magnetic blow-out coil; the alternating switches are provided with carbon sparking tips. Thanks to the gradual acceleration of the load, only a small number of turns of the rope need be put round the drum, so that easier handling and quicker manipulation are obtained. For the same reason, when the load is being started, instead of having to let the rope slip on the drum it can be pulled tight, causing the load to get under way more speedily.

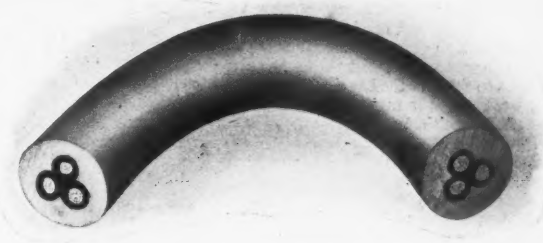
Geared Capstan (Union Electric Co., Ltd.).

We are informed that over 800 of these capstans have been made and supplied, quite a large proportion of them to mines on the Continent. One of the largest direct-acting capstans has recently been installed on the system of the Great Northern Railway of Ireland, and two of the A.C. type are at work in a coal yard in Ireland.

The St. Helens Cable and Rubber Co., Ltd.

The question what type of cable to employ in mines is one which has exercised the brains of electrical engineers ever since electricity was first introduced below ground, for the conditions to be complied with there are almost unique in difficulty and severity. The constant presence of corrosive moisture and warmth, the liability to breakage by falls of roof, and the rough handling to which the cables are subjected, call for the toughest and most durable insulation and mechanical protection, while the possible consequences of a leak or break, in the shape of fatal shock or explosion, intensify the anxieties of those responsible for the upkeep of the installation. The St. Helens Cable Co., having their domicile in the midst of a coal-mining district, naturally had their attention directed to the matter from the earliest days, and specialised in cables for collieries. For this class of work their well-known Dialite cables are largely used, as they are insulated with Dialite vulcanised bitumen, a substance which is practically imperishable and proof against moisture laden with mineral matter. The company have also given much attention to the best methods of installing electric cables in mines, and of securing safety for the men who handle them.

One of the weakest points in the electrical chain is the trailer cable used for connecting coal-cutters to the gate-end box, which is constantly exposed to wear and to accidental damage, while, as it is continually handled by the men, any defect in the insulation may easily have fatal consequences. To overcome the difficulties of this problem, the St. Helens Cable Co. have recently put on the market a special flexible trailing cable, a section of which is illustrated herewith.



St. Helens Special Trailer Cable.

Each conductor of the single, twin or three-core cable is insulated in the usual way with pure and vulcanised rubber and taped. These cores are then twisted together, and completely padded and sheathed overall with the company's special cab tire compound. This material is made up in the same manner as their solid rubber tires for cabs and cars, &c.; having been large manufacturers of these for many years, they are in a position to know, from practical experience, the best compounded rubber for resisting wear on flinty roads, &c., and it occurred to them that a sheathing of this material would form an excellent protection for coal-cutter cables, a conclusion which has been borne out in practice. The initial cost is rather higher than that of the ordinary type of trailer cables, but we are informed that the special cable outlasts two, and sometimes even three, of the old type.

Gearless Type of Capstan.

R. Wolf.

Where coal is dear but steam power is necessary, as at mines remote from the seaboard, an economical prime mover is the Wolf patent superheated steam "Locomobile," which comprises in small compass a combined boiler, superheater and engine, occupying the minimum of floor space and requiring only light foundations. In these machines the engine is mounted on the top of the boiler, and the superheater is placed in the smoke box. The furnace is of cylindrical shape, and can be withdrawn bodily with the tubes, the furnace and tubes being built up between two plates which are bolted up steam and watertight to the boiler shell. The superheating coil can also be readily removed. Balanced piston valves are used, with a shaft governor, and automatic lubrication is provided.

A large number of these Locomobiles has been supplied for powers up to 600 H.P., not only for such work as is mentioned above, but also for permanent installation in electricity works, factories, mines, &c.; owing to their construction, they can be transported in parts over great distances into mountainous regions and other places difficult of access. A test conducted by Messrs. Burstall and Monkhouse last year on a 150-H.P. Wolf tandem compound condensing Locomobile, with superheater, showed a consumption of 1·05 lb. of coal, and 8·81 lb. of water per B.H.P.-hour at full load; but we are informed by the makers that they have recently obtained a consumption of 0·78 lb. coal, and 7·6 lb. steam per B.H.P.-hour.

The Electric Construction Co., Ltd.

The Simplex (electric) bar coal-cutting machine, manufactured by the above company, possesses two outstanding features, namely:—

The Simplex machine cuts both ways without alteration in the position of the main frame; most machines, whether of bar, chain or disk type are made to cut one way only, and those which cut both ways have to be turned bodily round, end for end, requiring considerable space in which to do this.

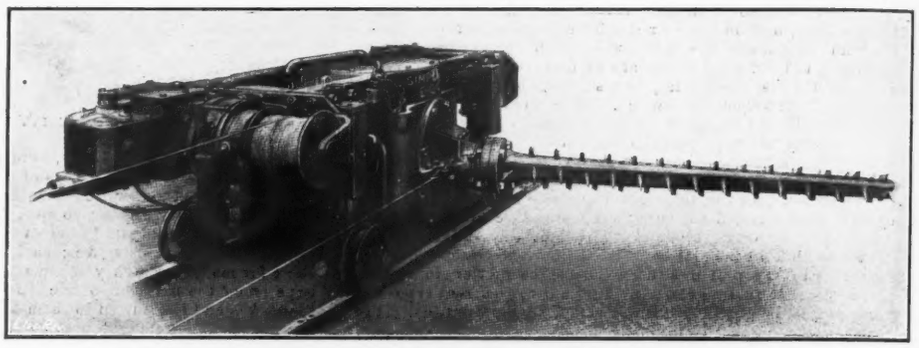
The Simplex machine is the only one transmitting power direct to the cutter without intermediate gearing, and thus giving a greater mechanical efficiency.

The hauling gear is of the friction type, with an epicyclic train of gear enclosed in a dust-tight case, and running in oil; it is adjustable as to rate of feed while the machine is running, according to the nature of the material and condition of cutters. The machine is travelled either on rails or skids.

The electrical equipment consists of a motor, control switch, resistance and interconnecting cables.

The motor is steel-clad and flame tight (either A.C. or D.C); the control switch is double pole, with renewable contacts of the floating type, which readily adjust themselves to the fixed contacts.

For three-phase alternating work, the switch is of the barrel type; switch and resistance are both contained in a flame-tight case, which can be oil filled if desired.



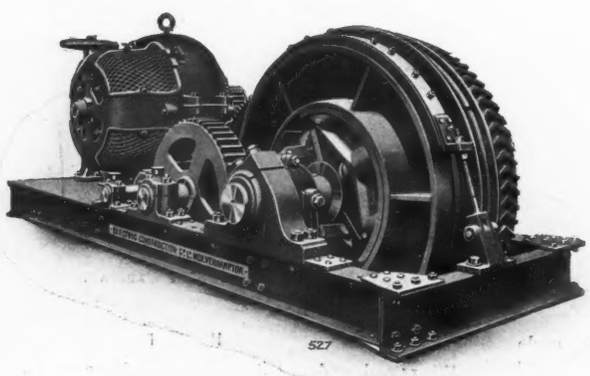
E.C.C. "Simplex" Electric Coal-Cutter.

The three sizes of machine, 15, 20 and 25 B.H.P., measure approximately 2 ft. high × 3 ft. 6 in. wide, and are 7 ft. long.

Among other mining matters the Electric Construction Co. have made a speciality of haulage gears of the single-drum main-and-tail and endless types.

We illustrate below a complete endless haulage gear of the company's design, constructed throughout in their works (as in the case of all their haulage gears). The gear is carried on a built-up steel frame, and consists of a cast-iron surge wheel with renewable steel tread for the rope; this is driven through a half-moon friction clutch operated by means of a hand wheel and screw, and is fitted with an all-round band brake operated by a foot lever.

In all standard haulages the first-motion gear consists of a rawhide pinion and cast-iron spur wheel, with machine-cut teeth; the second-motion gear is of cast-iron with plain-shrouded machine-moulded teeth up to 25 B.H.P., and above that size, with double-helical teeth as shown in our figure.



E.C.C. Endless Haulage Gear.

An E.C.C. enclosed ventilated motor designed for continuous running drives the gear, as shown; the D.C. starting rheostat or A.C. oil-type rotor starter, as the case may be, is arranged for fixing to a wall near by.

The details of the main-and-tail and single-drum haulages differ somewhat from the above, owing to the inclusion of cast-iron haulage drums, with sliding claw friction clutches in place of the surge wheel in the endless haulage.

Further, the driving motors are rated upon an intermittent basis, and provided with tramway type controllers and either coil or grid resistances.

Three standard sizes are built in all types of haulage gear, viz., 25, 50 and 75 B.H.P., the rope speed in the case of the endless type being 2 miles per hour, and for other types, 7 miles per hour.

The gears are of massive design, and both the mechanical and electrical features have been carefully studied.

Belgian Quarry Electrification.

Some statistics which have been published regarding the use of electricity in Belgian quarries, throw considerable light on the up-to-date methods adopted in that small but progressive kingdom. Thus it appears that some 10,000 H.P. of electrical energy is in use for quarrying and dressing stone. For the former purpose winches take 2,200 H.P., and travelling cranes, 1,500 H.P.; for the latter purpose, cranes and transporters absorb 1,400 H.P., reciprocating pumps 300 H.P., centrifugal pumps 900 H.P., and the balance is utilised for motor-driven machinery, lighting, &c. This development concerns some 50 quarry companies, which in some cases supply other industrial concerns in addition to their own plant.

Such a record reminds us of the comparatively few instances where British quarries have adopted electrical driving, and of the numerous localities where steam or hand-cranes still suffice for the quarrymen, although within a mile or two of electric supply cables.

Possibly the comparatively dull times experienced lately by the English stone trade may be traced to this disinclination to adopt modern methods of reducing expense. We are, however, compelled to admit that a purchased supply of energy, involving, in many cases, the use of long underground feeders—owing to the obstacles placed in the way of overhead transmission in this country—would be more costly than appears at first sight.

Ferranti Manufactures.

Messrs. Ferranti, Ltd., Hollinwood, Lancashire, have issued a four-page publication, giving an alphabetical list of their various electrical manufactures, and a list of their many branches and agencies in this country and all parts of the world.

The Japan-British Exhibition.

The Duke of Norfolk as President of this Exhibition, writes as follows:—"Might I ask you through the medium of your columns to impress upon all participating in the British Section of the Japan-British Exhibition, the necessity of taking advantage of the facilities afforded by the Administration in order to have their exhibits completely installed in ample time before the opening early in May. The Japanese have already made great progress, and there is no reason why British manufacturers, who are on the spot, should be one whit behind their Far Eastern colleagues. In the past many a valuable exhibit has been entirely passed over by both Press and Public, because on the first visit to the Exhibition they had no opportunity of forming a judgment upon its merits. As the advantages of preparedness are, therefore, so evident, I trust that all those taking part in the Japan-British Exhibition will do their utmost to ensure that no reproach shall attach to the British Section when the day of opening comes."

Reproach did undoubtedly attach to many people on the occasion of the opening of the Franco-British Exhibition. It is to be hoped that both management and exhibitors will on this occasion heartily co-operate to prevent the bungling that occurred almost everywhere then.

Lea Recorders.

The Lea Recorder Co., of 28, Deansgate, Manchester, has recently received many orders for these recorders for boiler, engine and turbine tests, amongst their customers being the following:—

Nitroglycerin Aktiebolaget, Stockholm.	Ryde Pumping Station, Australia.
Corporation Electricity Works, Glasgow.	London Hydraulic Power Co., London.
Corporation Sewage Works, Stockport.	Corporation Electricity Works, Halifax.
Corporation Electricity Works, Brighton.	Municipal Tramways, Adelaide, Australia.
G.P.O. (three sets), London.	Corporation Electricity Works, West Bromwich.
J. G. White & Co., Ltd., London.	Broken Hill South Silver Mines, Australia.
Corporation Electricity Works, Cardiff.	Sydney City Council, Australia.

The British L. M. Ericsson Manufacturing Co., Ltd.

The instrument illustrated below is constructed by the company specially for use in mines. The framework is made of cast-iron, thoroughly coated with enamel and stoved. All the metal parts are well covered with black lacquer. The switch-hook and the bell armature shown are fitted so as to be absolutely watertight at the point where they enter the case, and all the joints are arranged with rubber packings.

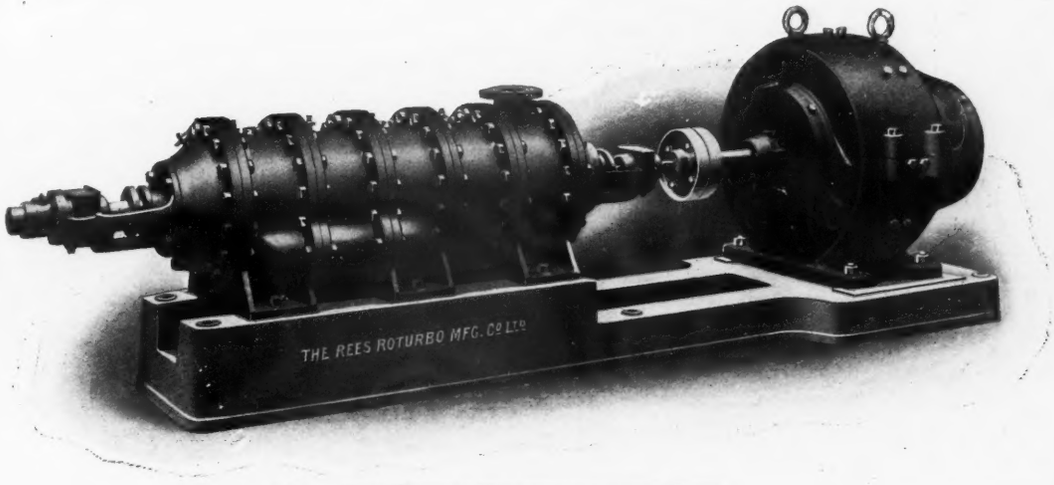
L. M. Ericsson Mining Telephone.

A hand set is supplied, fitted with patent watertight non-mouthpiece transmitter and special receiver, and the cords have waterproof coverings.

The instrument is wired for use on a common-battery system; the makers claim that it is thoroughly up to date, carefully thought out, and perfectly reliable for use in mines.

The Rees Roturbo Manufacturing Co., Ltd.

We referred at some length in our issue of November 26th last to the recent developments in centrifugal pumps by the Rees Roturbo Co., of Wolverhampton, who utilise an impeller of special design, having a large internal capacity, with a view to securing a constant internal pressure independent of the head, and improved self-regulating features.



Rees Roturbo Electrically-driven Pump.

Our illustration shows one of these pumps of the multi-stage type, direct-coupled to a direct-current motor, and supplied for mining purposes.

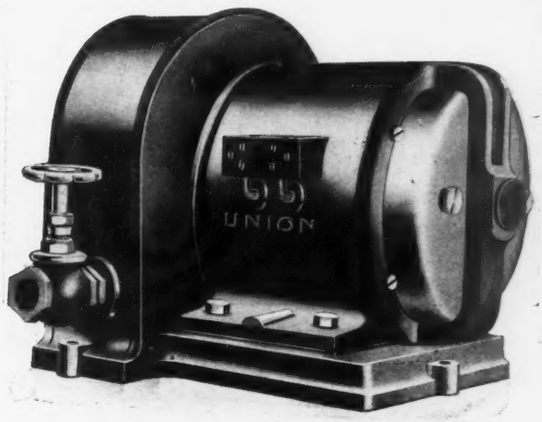
The duty of the pump is 13,200 gallons per hour, against 500 ft. head, with a speed of about 1,440 R.P.M. The pump is of standard design, and the motor of 52 B.H.P. capacity, operating on 500 volts pressure.

Electric Lighting Accessories.

Messrs. D. H. Bonnella & Son, Ltd., of 58 and 60, Mortimer Street, London, W., in section L of their catalogue just issued, give illustrations, brief particulars, and prices of various accessories for electric lighting, including wall sockets and plugs and pressel switches.

The Union Electric Co., Ltd.

A neat little hydro-electric generator is supplied by the Union Electric Co., Ltd., for use in situations where water-power is available, as in many mines, country houses, &c. The set is designed to operate with any head of water exceeding 120 ft., being provided with a stop valve adjustable to suit the pressure; it is completely encased in cast-iron and phosphor-bronze, no moving parts being visible, and is water and dust tight. There is only one moving part, which is carried in two Hoffmann ball bearings, fitted with automatic lubrication. Light is frequently required in parts of the underground workings of a mine which are beyond the reach of the



"Union" Hydro-electric Generator.

ordinary electric supply, but where water under pressure is available, and in such a case this set, which can be connected by a 1-in. pipe to the nearest rising main, should be found very serviceable; it has been specially designed to run on load continuously for six months at a stretch without attention, with a view to meeting the arduous conditions of mining work. The standard size is capable of supplying up to 20 25-volt metallic-filament lamps, and is so designed and wound that neither switches nor fuses are required in the circuit, so that it can be used with safety in gassy mines. The accompanying illustration shows the standard pattern, which occupies a space of 14 in. × 12 in. × 11½ in. high, and gives 8 amperes at 25 volts. It is, of course, very suitable for charging a small set of accumulators or lighting a private house where a high-pressure water supply is available.

Pneumatic Tools.

There has just been published by Messrs. Balcke & Co., Ltd., of 27, Clements Lane, London, E.C., a collection of lists forming a catalogue of their Empire pneumatic tools and appliances, and complete pneumatic installations. The lists are all well and fully illustrated, and the different sections contain, in addition to descriptive matter, tabulated capacities, sizes, weights, and prices, of chipping, caulking, and riveting hammers; sand rammers and riddlers; drilling hammers and stone-cutting tools; jam and gap riveters; hose pipes, couplings and cocks; air compressors, receivers, and filters, and portable plants. We understand that these tools and compressors are now being put on the English market for the first time.

Clarke, Chapman & Co., Ltd.

The accompanying illustrations show some interesting examples of recent work carried out by Messrs. Clarke, Chapman & Co., Ltd. Fig. 1 is a view of an electrically driven portable pump;

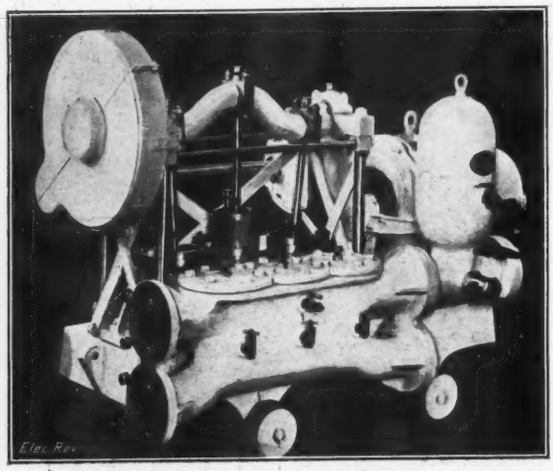


Fig. 1.—Electrically driven Three-throw Portable Pump.

it shows the type of pump often used where the head against which the water to be delivered is not great—say up to 100 ft.—and where the pump is frequently moved from one place to another, the wheels being arranged for the ordinary tub gauge. The pump delivers 9,500 gallons per hour against a head of 100 ft.

Fig. 2 shows an electrically driven haulage gear, suitable for auxiliary electric haulage—that is to say, for hauling small numbers of tubs from the coal face to the main road, at a speed of 3 miles per hour. The drum is made loose on the shaft, and is driven by a claw-clutch, so that when working on an incline the drum can be unclutched for running the empty tubs in to the face. The main pair of gear wheels have machine-moulded double-helical teeth, and the motor pinion and its wheel have machine-cut straight teeth, the motor pinion being made either of best raw hide or of gun-metal. Steel pinions might, of course, be used, but they make more noise; the raw hide is the most silent gear, but is not always satisfactory in damp situations.

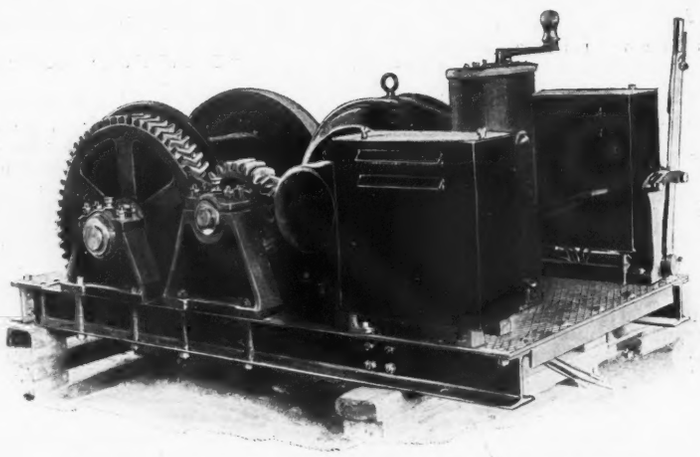


Fig. 2.—Clarke, Chapman 20-h.p. Single-drum Haulage Gear.

The frame of the gear is built up of channel sections bolted together, so that it can easily be taken apart when it is desired to change the position of the haulage.

A tramway type controller is provided for the motor, as the makers consider this type the most satisfactory for these small semi-portable haulages. Liquid starters are often proposed and sometimes asked for, as they are somewhat cheaper, but where the gear is to be moved about they are not so convenient.

An electrically-driven winding gear is shown in fig. 3. This is a small winder designed for working a staple underground, and, as will be seen from the figure, it has two drums, each with a groove for the rope machined in it.

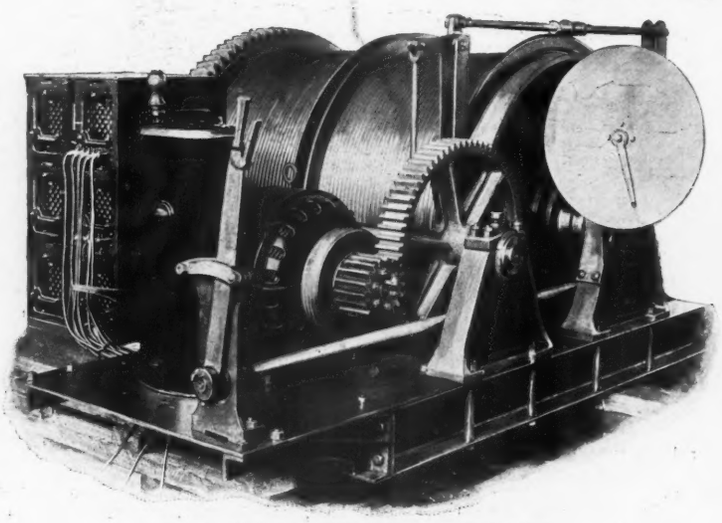


Fig. 3.—20-h.p. Double-drum Winding Gear.

One drum is keyed to the shaft; the other is loose on the shaft and is driven by a claw-clutch, so that the relative positions of the two cages can be changed.

The loose drum is provided with a brake on one rim, so that it can be held when unclutched from the shaft. A magnetic brake is provided on the motor shaft, which is available for the drum keyed to the shaft when the loose drum is unclutched, and for both drums when both are in gear. As in the case of the haulage gear described above, the main spur gear has double-helical machine-moulded teeth, and the motor gear is machine-cut.

In this case each drum was made in halves, owing to the small section of the roads through which it had to pass to its working position, and the girder frame is bolted together so that it can be easily transported. The depth indicator is driven from the drum shaft, so that it shows the position of the cage attached to the drum which is keyed to the shaft, but not that of the cage attached to the loose drum. The gear was designed for an unbalanced load of 1,000 lb., at 500 ft. per minute.

Electrical Plant at Murton Colliery, Durham.

About two years ago the haulage and pumping plant at the Murton Colliery, County Durham, was converted to electrical operation. The colliery has an output of 4,000 tons per day, and dates back to about 1840.

Originally five main haulages and four underground pumps, all steam driven, were supplied from an underground installation of 20 boilers, of the externally-fired cylindrical, Babcock, and Lancashire types; an underground furnace assisted by the heated gases from these boilers was utilised for ventilation.

The new plant installed when the old steam plant was displaced consists of five electrical haulages of 400, 300, 300, 200 and 150 B.H.P. respectively. The Hawthorn haulage of 400 B.H.P. is one of the largest underground haulages known; it deals with 60 tubs (45 tons) over a distance of 13,464 ft., and is fitted with an auxiliary 200-B.H.P. motor, connected through a clutch, for hauling men and boys at reduced speeds. Tests show the maximum load on this haulage to be 610 B.H.P.

In the case of the two 300-B.H.P. haulages, the most important landings are 9,000 and 9,900 ft. from the shaft, and the loads 45 and 50 tons respectively. The three motors mentioned above are provided with liquid controllers, the others with metallic type controllers.

The main pumps, which work against a 1,224 ft. head, and deal with 200 gallons per minute, consist of two three-throw ram pumps, gear and rope driven from 120-B.H.P. induction motors. Two other three-throw ram pumps of smaller capacity are also in use, driven by 30 and 60-B.H.P. motors.

In substitution for the old ventilating arrangements, two duplicate single-inlet Capel fans, each with a capacity of 500,000 cb. ft. of air with a 4-in. water gauge, and rope driven by a 400-B.H.P. 12-pole induction motor, have been installed. Energy for operating the installation is purchased from the Durham Collieries Power Co.'s plant, some 8 miles away; the supply is three-phase at 5,500 volts, through duplicate cables to a surface sub-station, where it is split up for the ventilating fans (at 5,500 volts), for underground haulages and pumps (at 2,000 volts), and for supplying a number of slip-ring motors operating screening machinery on the surface, at 500 volts

ADAMS MANUFACTURING CO.'S "IGRANIC" ELECTRICAL WORKS.

A short time ago we had the pleasure of paying a visit to the Electrical Works of the Adams Manufacturing Co., Ltd., Bedford—a firm whose name and mystic trade mark "Igranic" are everywhere identified with motor-starting switchgear and controlling apparatus. As our readers are aware, the great development in the use of electrical power in recent years found the motor manufacturers somewhat ahead of the switchgear makers, so that for some time the cost of a satisfactory controller amounted to a very heavy percentage on the cost of the motor itself, and for certain particularly arduous duties absolutely no suitable apparatus was available. For example, when electrical power was first being applied to printing machinery, nothing better than a tramcar controller was available to cope with the fiery trials to which the printing machine minders subjected the unlucky starting-switch, and even that would not stand the racket for long.

By simplifying the construction of the switchgear, improving its design, and cheapening the cost of production, the Adams Manufacturing Co. have secured a leading place in this branch of electrical industry, and they are to be congratulated upon the success of their operations, which has resulted in the development of the works at Bedford to meet the demand for their specialities.

The "Igranic" works are situated alongside of the same company's automobile works, which are about the same size, on an estate of 6 or 7 acres: the buildings are of fire-proof construction, with saw-tooth roofs. The electrical works have a floor area of 22,050 sq. ft., including a gallery of 4,050 sq. ft. The main machine department, which is situated between the two works, is common to both.

The lay-out of the works has been designed in accordance with modern principles, with a view to securing economy of labour and space, and efficiency in production. As small parts predominate, and are required in great numbers, piece work is the rule throughout, and the various stores necessarily form an important department. All raw materials, except castings (which first pass through the enamelling department), after being checked, are passed into the "raw materials" store; thence they are issued on stock orders to the machine department, whence they pass into the "finished parts" store. From this the parts required for the assembling of small motor-starters and other rheostats are drawn by the "detail assembling department," which occupies the gallery; the "fronts" of rheostats are assembled, inspected and tested, and then returned to store until wanted for complete rheostats, when they are fitted in the resistance room with resistances already wound and tested. Every finished rheostat is carefully inspected and fully tested, and, if fitted with no-volt and overload release coils, is calibrated, before going into the warehouse as finished stock. The stock of complete standard starters, from $\frac{1}{4}$ to 50 H.P., seldom falls below 1,000, besides which a variety of other standardised apparatus is kept in stock.

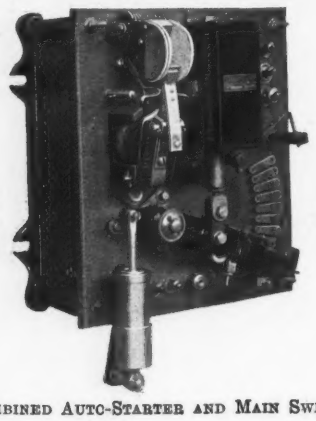
Heavier apparatus, such as large starters, controllers, and switchboard panels, are handled on the main floor in the

Views in the Machine Department.

Assembling Department. Detail Assembling Department.

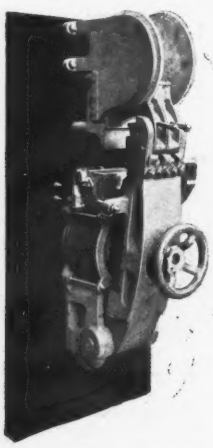
"assembling department," which is divided up into sections devoted to different classes of work. These apparatus are built up like the rest from finished parts drawn from the stores, but instead of going into the warehouse, they pass into the test room on the ground floor, where both A.C. and D.C. are available for testing purposes, and after testing and final inspection, they go to the packing department for shipment.

With the aid of a "bird's-eye view" board in the overseer's offices, which, with the works and drawing offices, forms part of the establishment, the works manager is enabled to keep track of every job in progress through the works, and to ascertain at any moment the position of affairs.



Combined Auto-Starter and Main Switch.

On the occasion of our visit, when a considerable number of representatives of the technical Press were entertained at luncheon by the company, with Mr. A. H. Adams presiding, a large number of lantern views were shown and described by Mr. Mould. These represented many interesting examples of the company's work, and that of the allied firm in the United States. Most noteworthy amongst the latter were views of the great rail mills at Gary, some of which we have already illustrated. One of the mill motors is of 6,000-H.P., and is controlled by an Igranic controller.



Clapper Type Remote-Control Switch.

Many interesting rheostats, &c., were also seen in the works; we illustrate a selection of these.

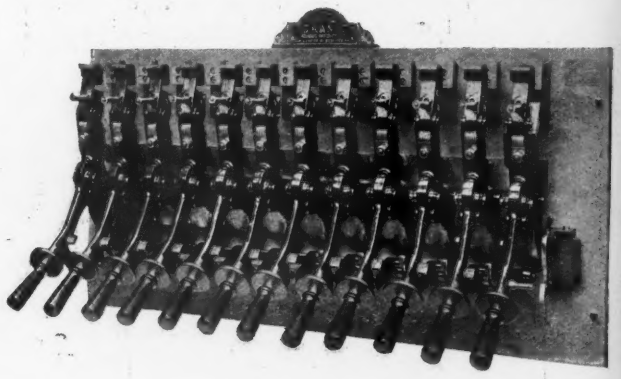
One of the most typical examples of the company's manufactures is, of course, an automatic starting-switch; the one illustrated above is a combined auto-starter and main switch, suitable for the automatic control of pumps, air-compressors, &c. It will be noticed that a neat little automatic circuit-breaker, with magnetic blow-out, is mounted at the left-hand of the starter, in accordance with the Adams Manufacturing Co.'s principle that when starters are to be frequently operated, the circuit should always be broken only on a device specially adapted for that purpose, and not on the rheostat segments.

Another illustration shows a very large automatic switch of similar design for remote control; this switch has heavy laminated copper brushes to carry the main current, with renewable copper and carbon sparking tips and magnetic blow-out. The example shown is capable of carrying 2,000 amperes at 600 volts.

A novel and ingenious multiple-switch "straight-line" starter is shown in the following figure. While there are six switches, there is only one handle, at the top. The bottom switch is the first to go in, and is held in by a no-volt release magnet; it is also provided with carbon break and magnetic blow-out. The switches are closed in succession by an up-and-down motion of the handle; but unless the bottom switch holds in, none of the others can be operated, nor can any switch be actuated unless the next one below it is in. If the bottom switch is opened by the action of the no-volt release (or overload, when this is fitted) the whole lot come out. This type of switch has been specially designed for enclosing in dust and watertight covers, or oil immersion.

Straight-Line Multiple Switch Starter.

The remaining illustration represents a toggle-joint multiple-lever starter, in which all the switches are interlocked, so that it is necessary to hold in each lever until the next in succession has been closed; no switch can be left open, nor can it be closed except in the correct order. The contacts are provided with laminated copper brushes, and each switch has an auxiliary renewable copper sparking tip, making contact with a heavy carbon brush. The toggle action minimises the effort required to close the switches, but the necessary hand-over-hand motion ensures that the resistance shall be cut out slowly.



Toggle-Joint Multiple-Lever Starter.

These examples will serve to show that the Adams Manufacturing Co., Ltd., do not merely manufacture switchgear—they also invent it, and are, therefore, well up to date. Their resistances also combine simplicity and ingenuity; these are made in several types, including an open cage of stretched strip (kept taut by a spring), cast-iron grids of remarkable toughness and flexibility, spirals of wire wound on asbestos tubes, and, for the smallest sizes, fine wire wound on porcelain blocks of lozenge section, afterwards covered with a special hard-setting cement. Wire wound on mica is also employed. For joints between successive spirals a simple copper mechanical connector is used, which is found to give complete satisfaction, and is, of course, independent of solder.

NOTES.

(*Continued from page 642.*)

Institution and Lecture Notes.—The Iron and Steel Institute.—The annual meeting of this Institute takes place in London (Institution of Civil Engineers, Great George Street, S.W.) on Wednesday and Thursday, May 4th and 5th, at 10.30 a.m. The new president, the Duke of Devonshire, will deliver his inaugural address. The following papers are expected to be submitted to the meeting:—

"On the Chemical and Mechanical Relations of Iron, Manganese and Carbon," by J. O. Arnold, D.Met. (Sheffield), and A. A. Read, M.Met. (Cardiff).
"On the Girod Furnace and the Electric Smelting Works of the Paul Girod System," by Prof. Dr. W. Borchers (Aix-la-Chapelle).
"On the Progress of Electro-Smelting," by Donald F. Campbell (London).
"On Some Recent Investigations on Case Hardening," by Sydney A. Grayson (Birmingham).
"On the Cutting Properties of Tool Steel," by E. G. Herbert (Manchester).
"On the Crystallography of the Iron-carbon System," by V. A. Kroll, jun. (Frankfort-on-the Main).
"On the Constitution of Cast Irons and Carbon Steels from the Practical Standpoint," by D. M. Levy (Birmingham).
"On Some Physical Properties of Two Per Cent. Chromium Steels," by Prof. Andrew McWilliam, Assoc.R.S.M., M.Met., and E. J. Barnes (Sheffield).
"On the A2 Critical Point in Chromium Steel," by Harold Moore, B.Sc. (Woolwich).
"On the Economy and Design of Modern Reversing Rolling-Mill Steam Engines," by Eduard G. Schmer and Dr. Rudolf Drawe (Saarbrücken).
"On Developments in the Production of Electric Power: Its Application and Bearing upon the Iron and Steel Industries," by D. Selby-Bigge (Newcastle-on-Tyne).
"On the Elastic Breakdown of Certain Steels," by Prof. C. A. M. Smith, B.Sc. (London).
"On the Homogeneity of Metals," by G. Tagayeff (St. Petersburg).

The Secretary (Mr. G. C. Lloyd) asks us to state in connection with this meeting, that the Lancashire and Yorkshire Railway is included among the railway companies who have joined in granting a reduction in return fares, from May 3rd to 6th inclusive, to members of the Institute travelling to London to attend the annual meeting.

The Institution of Electrical Engineers (London.)—The nominations for election of Council and officers for the year 1910-11 announced at the ordinary general meeting yesterday, were as follows:—

President.—S. Z. de Ferranti (new nominee).
Vice-Presidents.—W. H. Patchell, J. H. Rider (new nominees); W. Duddell, F.R.S., S. Evershed (remaining in office).
Members of Council.—H. Dickinson, J. E. Kingsbury, P. V. McMahon, R. K. Morcom, S. L. Pearce (new nominees); W. W. Cook, G. K. B. Elphinstone, W. Judd, Prof. T. Mather, F.R.S., W. M. Morrison, Major W. A. J. O'Meara, C.M.G., J. F. C. Snell, G. Stoney, A. H. Walton, C. H. Wordingham (remaining in office).
Associate Members of Council.—S. Morse (new nominee); E. Russell Clarke, J. E. Taylor (remaining in office).
* *Honorary Treasurer.*—Robert Hammond (new nominee).
* *Honorary Auditors.*—H. Alabaster, Sidney Sharp (new nominees).

* Retire annually and are eligible for immediate re-election.

Institution of Mechanical Engineers.—The annual dinner of the Institution was held at the Hotel Cecil on Thursday last week, Mr. J. A. F. Aspinall, the president, being in the chair.

Electric Shock Fatalities.—On Saturday last an inquest was held into the death of Llewellyn Evans, 26, electrical engineer, which occurred on Wednesday last week, at the Birmingham, Tame and Rea District sewage disposal works at Bromford. According to the report in the *Birmingham Post*, Dr. F. W. Clark, who was called immediately after the accident, said that there was the mark of a burn on the left boot and one of the toes. He ascribed death to electric shock, which had arrested the heart's action.

Louis Mountfort, an electrical engineer in the service of the Drainage Board, said that deceased had been employed at the works as chief operating electrical engineer for 2½ years. On the day of the accident deceased and himself and two other electricians were testing a newly-installed electrically-driven motor. By the time of the accident the machinery had been under test at full load for six hours. One of the principal objects of the test was the fixing of a measuring instrument to gauge the current, and it was on this work chiefly that Evans was engaged. During the full load testing the instrument was short-circuited in order to save the current from passing through, and being registered by it. Evans expressing the opinion that the voltage—6,000—being employed, would damage the instrument. A consultation on this point was held shortly afterwards, and resulted in a determination to allow the current to pass through the instrument. Evans left his (witness's) sight at this point, and a moment later he heard an exclamation, followed by a gasp. Evans was found lying unconscious near the instrument. Artificial respiration was tried, but without avail. He (witness) conjectured that Evans went to make the alteration in the connections he and his colleagues had decided upon, and, forgetting that the current was on, touched the live wire.

The Coroner: Did you know that the switches were not disconnected, and that the current was on?—Witness: I knew that they were not disconnected. And you had reason to think he knew?—He did know a few minutes before, there's no doubt about it. His going towards the instrument, instead of to the switch, indicates to my mind, absolutely, that he must have forgotten that the main switches were closed. He was wearing a rubber glove, I believe?—Yes, but a rubber glove is no protection against 6,000 volts. He would be doing this entirely without directions from anybody else?—Yes. Replying to further questions, witness said no one actually saw Evans killed because he went behind the switchboard, apparently to the instrument. "My suggestion is," added the witness, "that momentarily he forgot the switches had been put in, and that he went straight back to his instrument without seeing whether they were in or out." There is no suggestion that any part of the machinery was out of order?—Not in the least. It is agreed that everything was running properly?—Yes. Could this alteration possibly have been made without great danger?—The proper course would have been to see that the switch was off. Protective appliances are not provided for work of this description?—They are provided for general use, but no one would think of using them for 6,000 volts. There was no neglect, then, to provide these things?—No; there could be no neglect, because they were unnecessary. You don't think any precaution whatever might have been taken, except that of switching off the current?—To make it absolutely safe, I don't think so.

At this point the jury visited the switchboard, and inspected the instrument. On their return, the Coroner said it had been suggested to him by a juryman that it would be safer if the measuring instrument were placed between the starting point and the motor, because then no such accident as the present one could happen from forgetfulness. The electrician would be reminded the current was on by the noise of the running motor. While agreeing with the suggestion, Mr. Mountfort pointed out that during this test, although the current had been on, the motor had not been running.

Answering Mr. Harding, the witness said that although a strongly insulated floor would reduce the risk of approaching a wire conveying current of 6,000 volts, there would still be a risk, and one he would not take under any circumstances. Replying to Mr. Watson, the witness agreed that an insulated floor might produce a false sense of security. It was better that a man should realise fully the danger of approaching a live wire carrying 6,000 volts, and that there could be no degree of safety in the presence of it.

Mr. H. Kemp, Mr. Evans's assistant, and Mr. H. W. Fisher, engineer in the employ of Messrs. Crompton's, London, who supplied the motor, said they agreed entirely with everything Mr. Mountfort had said. It was their opinion also that Evans must have gone to the instrument forgetful of the fact that the current was on.

Reviewing the evidence, the Coroner said it was inconceivable that a man of Evans's experience, knowing the current was on, would have attempted to remove the wire. The jury returned a verdict of "Accidental death," and, through the foreman, expressed the opinion that if any precautions could be taken to prevent such an accident occurring again, they were sure the members of the Drainage Board would act upon them.

A joiner named Walter Liddle, aged 33, of Newbottle, was killed on Friday at the power station of the Durham Collieries Power Co., Ltd., at Philadelphia, Co. Durham. Liddle was employed by a firm of contractors in doing some work at the power station, and by some means one of his arms came in contact with a conductor, his other arm being in contact with the earth. A current at 3,000 volts passed through his body and death was instantaneous.

It is reported that on Wednesday a young collier named Harry Calladine, of Wessington, was killed by coming into contact with a live wire while working an electric coal-cutting machine at South Wingfield Colliery, Alfreton.

Electric Hoisting in Mines.—The application of electric motors to mine hoisting, which has made considerable progress of late years in the United States and Mexico, has reached its greatest development hitherto in Germany and France, especially in the former country, and its least, among the great mining centres of the world, in Great Britain. There seems to be no question that the electric mine hoist must eventually displace entirely the steam hoist, and in this connection it is interesting to note that the German Government permits a maximum speed of 1,980 ft. per minute for hoisting men by electricity as against a maximum of 1,188 ft. per minute allowed in the case of the well-tried steam hoist.

Other applications of electricity in mines furnish a comparatively constant load, and hence with these the load factor is high and the application of electricity is fairly simple; with electric hoists, on the other hand, the load is intermittent and extremely variable, and special precautions must be taken to equalise the load, both to improve the load factor and to prevent dangerous surges on the line.

When the hoist is designed to operate on a comparatively slight grade, the problem is not so difficult. In a recent example of grade hoisting, in the mine of the Washington Coal and Coke Co., at Dawson, Pa., the grade varies from 5·0 to 8·5 per cent. The hoisting drum is 6 ft. in diameter, and is driven by a 500-H.P. D.C. non-reversing compound-wound motor, controlled by a semi-automatic magnetically controlled unit-switch controller. Line surging is practically eliminated in this case by using an accelerating relay on the controller, to prevent the starting switches from closing too rapidly. A safety relay is also provided which opens the resistance switches in cases of excessive overload. A further protection is afforded, as in the case of cars striking an obstruction, by a feature in the design which permits the motor automatically to be brought up to full speed again should the relay operate when the motor is running. In this particular installation the empty

cars run down the slope under gravity and are controlled in their descent by a brake on the hoist drum. The hoist is installed on the 800-ft. level, and it may safely be said that it could not be operated in the existing circumstances by any other than electric power.

A noteworthy example of the motor-generator fly-wheel system is that in the mine of the El Oro Mining and Railway Co., Ltd., in Mexico. This set consists of a 350-H.P., 50-cycle, three-phase, 3,000-volt induction motor, and a 320-KW., D.C., 250-volt, interpole generator, with a 40,000-lb. fly-wheel, 9 ft. in diameter, mounted between the two machines on the common shaft. The 17-KW., 125-volt exciter is belted to a pulley on the main shaft of the set at the side of the fly-wheel.

The chief purpose in using the motor-generator fly-wheel set for hoisting lies in the fact that the fly-wheel acts as a reservoir for energy which can be drawn upon when the peak loads are encountered, especially in accelerating. In this way the motor input is equalised in a degree depending on the kinetic energy of the fly-wheel. The slip in the motor must, of course, be varied in amount if this fly-wheel energy is to be utilised just when it is required. In the El Oro mine hoist this is accomplished by an arrangement which automatically cuts in and out grid resistances connected to the motor secondary. When the power is shut off the set will rotate over an hour before coming to rest (unless a brake be applied, which will stop the machinery in less than five minutes). This permits the hoist to be used for some little time in case the current is accidentally shut off, and it is for this reason that the exciter is driven from the set instead of separately. No repairs beyond the usual attention to the brushes have, so far, been necessary in this particular installation.—*Electrical Review and Western Electrician.*

Westminster Street Lighting.—At a recent meeting of the City Council, it was decided to accept the tenders of the Gas Light and Coke Co. for the lighting of certain districts in that city, including several of the most important streets in the West End. Some of these streets are at present lighted with arc lamps by the Charing Cross and West End Co. and the St. James's and Pall Mall Co., and the proposal to revert to gas lighting naturally aroused opposition on the part of the local ratepayers, notably in Regent Street and Piccadilly, who petitioned unsuccessfully for the adjournment of the question for further consideration. It appears that the tenders of the electricity supply companies operating in the areas concerned were greatly in excess of those of the Gas Co., not only for the installation, but also for the running and maintenance of the street lamps—an extraordinary result, in view of the indisputable fact, clearly shown, moreover, in the reports of the Westminster city engineer, that the cost for equal candle-power with flame arc lamps is only about half that of high-pressure gas lamps, and with Osram lamps far less than half that of low-pressure incandescent gas lamps. It is well known, and Mr. Bradley himself (the city engineer) has testified to the fact, that it is difficult to keep incandescent gas lamps, whether low-pressure or high-pressure, up to the mark; yet in the discussion in the Council it was stated that the engineer in his report showed that the gas company maintained the candle-power of their lamps better than the electric lighting companies! If this be true—which we doubt—more shame to the electric lighting companies. We are at a loss to understand this remarkable situation, which is totally at variance with previous experience and the numerous tests which have been carried out under actual service conditions; we can only suppose either that the electrical tenderers quoted unnecessarily—even absurdly—high prices, or that the gas people are counting upon the difficulty of maintaining a strict supervision over the candle-power of their lamps. Perhaps both factors enter into the matter—certainly £5 a year seems an extraordinary figure to quote for 90 C.P. under a 5-year contract, seeing that with metallic-filament lamps this involves an expenditure of only 100 watts. With a load factor of 45 per cent., can the electric lighting companies offer no better price than 3d. a unit inclusive? For arc lamps of 3,000 C.P. they asked £28 on a 5-year basis. These figures compare with £2 16s. 6d. and £22 respectively for gas. We feel that the electric lighting companies, by quoting these high rates—far in excess of prices at present in vogue in the same areas—have inflicted a serious injury upon the electrical industry, not only in London, but in the whole of this country.

The Experimental Turbo-Electric Locomotive.—The new locomotive, which has just been completed at the works of the North British Locomotive Co., Ltd., from the designs of Messrs Hugh Reid & Ramsay, and was described some time ago at Glasgow University, a report of the proceedings appearing in the REVIEW, is shortly to be tried over the Glasgow and South-Western Railway Co.'s system, probably about the end of the present month.

An Electric Sales Society.—The staff of the St. Marylebone Electric Supply have formed a society called "The Electric Sales Society," for the furtherance of business-getting in connection with electricity supply. The Society meets every fortnight in the winter and every month in the summer. At present it is confined to the staff of the St. Marylebone Electric Supply, but it is hoped in a short time to extend the scope of membership. Papers are given by experts on business getting, points relating to electricity supply, electrical apparatus and work of all descriptions, particular attention being paid to all papers concerning the commercial side of the question. The papers given and discussion following will be printed for sale and embodied in a monthly publication on electric sales work. We should think there is plenty of scope for such an organisation, and we wish it success.

International Electrical Units and Standards.—In the *Electrical World* of April 7th, Prof. E. B. Rosa gives a *résumé* of past work in the direction of securing uniformity in the international electrical standards, and explains the objects of the joint investigation which is being conducted at the Bureau of Standards, Washington, this month. At the International Electrical Conference of London, 1908, a Committee of 15 members was appointed to complete the work of the Conference, and elected five associate members; the English representatives are Dr. R. T. Glazebrook (vice-president), Mr. A. P. Trotter and Mr. F. E. Smith. It was desired to settle the value of the Weston Normal cell in terms of the ohm and ampere, but this could not be done until the value of the latter as determined by the silver voltameter had been defined more precisely than by the London Conference. An experimental investigation is therefore being carried out by Prof. E. B. Rosa and Dr. F. A. Wolff as representatives of the Bureau of Standards, jointly with Prof. Dr. W. Jaeger, of the Reichsanstalt; Mr. F. E. Smith, of the National Physical Laboratory; and Prof. F. Laporte, of the Laboratorie Central d'Electricité, with a view to fixing the value of the ampere and the Weston cell. The resistance standards of the respective national institutions will also be accurately compared. The Bureau of Standards has provided every facility for carrying on the work, which is expected to occupy about two months, and a large part of the expense is being borne by American societies.

Serrated Carbon Brushes.—In an article on "Commutation" in the *Electrical World*, Mr. F. W. Carter, discussing the conditions that must be satisfied in order to secure good commutation, shows that a considerable improvement can be effected by the use of carbon brushes with serrated edges, the toe of the brush being filed to a deep saw-tooth shape. By this means the area of contact of the brush with the receding commutator segment is made to vary at a more rapid rate than the first power of the time, a condition which is shown to be favourable to sparkless commutation. Experiments carried out on a machine that had poor commutating qualities proved the correctness of the theory, the vicious sparking observed with ordinary brushes being practically cured with the serrated brush. Another factor in commutation is the form of the commutating field, which, at any rate in the case of large bar-wound armatures, should increase towards the end of commutation. This can be effected by giving a suitable shape to the commutating pole, or by a forward displacement of the compensating winding where the latter is used.

For Sale.—The Croydon Council is offering for sale certain dry-back boilers, old transformers, arc lamps, scrap-iron and copper. See our advertisement pages for particulars.

The Electric Car and the Central Station.—According to a recent paper read in Boston, the St. Louis central station authorities have adopted an advertising and educational campaign in regard to the electric vehicle, and have established a $50,000 garage. In the result there are 350 electric cars in use now, as compared with 17 three years ago. Eight public garages are in use and about 60 rectifiers. The electric vehicle department has become self-supporting, although from the first the garage of the central station was charged with all the expenses of exploitation. The income from 46 rectifiers averaged $11·33 per month, and one garage paid $2,352 in six months for energy. Ninety per cent. of the load is of the off-peak variety.

The B.A. Meeting.—The President for the meeting of the British Association, which opens at Sheffield on August 31st, is Rev. Prof. T. Ct. Bonney, LL.D., F.R.S. The chairman of the Engineering Section will be Prof. W. E. Dalby, and of the Mathematical and Physical Science Section, Prof. E. W. Hobson, F.R.S.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Officials.—At a meeting of Taunton T.C. on Tuesday, Mr. Macdonald presented the report of the Electricity Committee, which stated that it had received the resignation of MR. E. B. THORNHILL, the electrical engineer, and recommended the Council to accept the same, but with permission for him to extend the time of notice to six months from the date of his resignation (February 28th) if he should so desire. The report was adopted.

MR. T. M. COLSON, who has been resident engineer at the Hamilton Corporation electricity works since their inauguration in 1902, and who has gone to take up another appointment at Surbiton under Edmondson's Electricity Corporation, was recently presented by his Hamilton friends with a Sheraton clock and aneroid barometer. The gathering also welcomed the new engineer, MR. SALTER.

Increases of salary (£25 in each case) have been granted Mr. R. B. Maccall, chief clerk; M. R. Mitchell, superintendent of street mains; and Mr. W. T. Calderwood, chief draughtman, all in the electricity department of the Glasgow T.C.

Mr. R. W. Grubb, assistant electrical engineer at Swindon, has resigned, he having secured an appointment under the Dewsbury T.C.

Mr. A. R. Sillar, borough electrical engineer at Colchester, has resigned.

Mr. L. A. Gomersall has been appointed to the position of assistant engineer to the Guernsey Electric Light and Power Co., Ltd.

Tramway Officials.—Mr. C. I. Baker, assistant traffic superintendent of the Newcastle Corporation tramways, has been appointed to the position of traffic superintendent to the Blackpool Corporation tramways. There were 132 applications for the vacancy.

Mr. James Stott has been appointed manager of the Heywood Corporation tramways, in addition to his position as electrical engineer.

Obituary.—The death has occurred at Newcastle-under-Lyme, following an operation for appendicitis, of Mr. Augustin Gifford Palgrave, electrical engineer, son of the late Sir Reginald Palgrave, K.C.B., for many years clerk to the House of Commons. He was 40 years of age. He formerly resided at Withington, Manchester.

General.—The Executive Committee of the National Physical Laboratory have appointed Mr. J. E. Sears, M.A., to take charge of the work of the Metrology Division of the Laboratory in the place of Mr. H. Homan Jeffcott, who has recently been nominated to the Professorship of Engineering in the Royal College of Science, Dublin. Mr. Sears, who was formerly at St. John's College, Cambridge, graduated with First Class Honours in Mathematics and Engineering, and is an Associate Member of the Institution of Civil Engineers.

Dr. Gnauth, who was formerly Hessian Minister of Finance, has been appointed general director of the Felten & Guilleaume-Lahmeyer Works, and will commence his duties on May 15th, at Mulheim, where the management of the whole of the undertaking will be concentrated in the future. This is said to be the first occasion for a former Minister of Finance of one of the Federal States to become the head of the management of a large manufacturing enterprise, although former Ministers of State are frequently to be found on the board of banking institutions. Dr. Gnauth, who passed the first State examination in engineering at the Stuttgart Technical High School, was appointed, after the second State examination, as Government Architect to the Wurtemburg-Hohenzollern Provincial Communal Union, and then became chief of the Hessian Ministry of Finance in 1900, where he remained for nine years and a half.

The employés of the National Telephone Co., Ltd., at Aberdeen, have signalised the completion of 25 years' service by the district manager, Mr. E. Emerson Stockens, and have presented Mr. and Mrs. Stockens with gifts as a mark of esteem. Mr. Thomas Mackenzie, contract manager, made the presentation.

The address of Mr. Albert Auer, consulting engineer, to whom reference was made in this column a week ago, is 216, Union Street, Aberdeen.

The directors of Messrs. A. G. Thornton, Ltd., Paragon Works, Manchester, have appointed Mr. A. J. Thornton to be managing director, in place of his father, recently deceased. There will be no change in the conduct of the business.

NEW COMPANIES REGISTERED.

Bedford & Co. (Cardiff), Ltd. (108,325).—This company was registered on March 22nd, with a capital of £1,000 in £1 shares, to take over the business of an electrical engineer, &c., carried on by C. E. Bedford at Frederick Street, Cardiff, as Bedford & Co. The subscribers (each with one share) are:—C. E. Bedford, 9, Kelston Road, Whitchurch, near Cardiff, electrical engineer; C. P. Godfree, 19, Church Street, Cardiff, electrical engineer; W. Roberts, 8, Fairoak Road, Cathays, Cardiff, engineer. Private company. The number of directors is not to be less than two or more than five; the first are C. E. Bedford and C. Godfree; qualification, £100. Registered by Alfred H. Atkins, Ltd., 27-8, Fetter Lane, E.C.

Stephen Cotton & Co., Ltd. (3,548).—This company was registered in Dublin on March 29th, with a capital of £20,000 in £1 shares, to take over the business of a machine maker, iron and brass founder, electrical engineer, carried on at Sidney Street West, Belfast, by Chas. C. Cotton under the style of Stephen Cotton & Co. The subscribers (with one share each) are:—C. C. Cotton, Brookfield Cottage, Belfast, machine maker; J. S. Cotton, 195, Clifton Park Avenue, Belfast, machine maker; H. C. Kennedy, 195, Clifton Park Avenue, Belfast, machine maker. Private company. The number of directors is not to be less than two or more than five; the first are C. C. Cotton, J. S. Cotton and H. C. Kennedy; qualification, 250 shares. Registered office, Sidney Street West, Belfast.

Foster & Pullen, Ltd. (108,579).—This company was registered on April 4th, with a capital of £5,000 in £1 shares, to carry on the business of gas engineers, electricians, plumbers, pump-makers, &c., and to acquire the business of lighting specialists and brass founders and finishers carried on by W. Grange and H. Pullen at Bradford as Foster & Pullen. The subscribers (with one share each) are:—G. Grange, The Nook, Eccleshill, Bradford, traveller; W. Grange, 30, White's View, Bradford, lighting specialist and brassfounder; H. Pullen, 21, Cobden Street, Listerhills, Bradford, lighting specialist and brassfounder. Private company. The number of directors is not to be less than two or more than seven; the first are W. Grange (managing director and chairman), G. Grange and H. Pullen. Registered by Jordan & Sons, Ltd., 116-117, Chancery Lane, W.C.

British Aluminium Co., Ltd. (108,758).—This company was registered on April 12th, with a capital of £1,000,000 in £1 shares (300,000 preferred), to acquire any minerals, clays or other substances suitable for the production or manufacture of aluminium, sodium, iron or other metals, to carry on the business of miners, manufacturers of and dealers in aluminium and its alloys, &c., to acquire and deal in any manner with all or part of the undertaking and assets of the Loch Leven Water and Electric Power Co., Ltd., and to adopt an agreement with the British Aluminium Co., Ltd. (in liquidation). The subscribers (with one share each) are:—H. T. Nash, Clovelly, Woodstock Road, Upper Walthamstow, clerk; A. J. Side, Jesmond Dene, Brondesbury Park, N.W., secretary; J. J. Hunter, 10, Dodbrooke Road, W. Norwood, S.E., chartered accountant; W. E. Taaffe, 70a, Portsdown Road, Maida Vale, W., clerk; F. Snow, 20, Exeter Road, Cedars Avenue, Walthamstow, clerk; H. W. Brown, 41, Mackenzie Road, Beckenham, clerk; W. H. Walford, 289, Mortlake Road, Ilford, clerk. Minimum cash subscription seven shares; the number of directors is not to be less than three or more than nine; the subscribers are to appoint the first; qualification (except first directors) as fixed by the company; remuneration according to profits. Registered by Ashurst, Morris, Crisp & Co., 17, Throgmorton Avenue, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Cambridge Electric Tramways Syndicate, Ltd. (79,744).—This company's annual return was filed on February 28th, when 107 shares had been taken up out of a nominal capital of £5,000 in £10 shares. £9 0s. 4½d. per share has been called up on 90, £10 per share on 10 and nil on seven shares, resulting in the receipt of £911 12s. 1d. Mortgages and charges: Nil.

W. P. Theermann & Co., Ltd.—Particulars of £1,000 debentures, created March 17th, 1910, filed pursuant to Sec. 93 (3) of the Companies' (Consolidation) Act, 1908, the whole amount being now issued. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

Metropolitan Electric Tramways, Ltd. (42,526).—Particulars of debentures to secure not more than one quarter of the paid up capital, created by resolutions of December 22nd, 1908, and March 11th, 1910, and secured by trust deeds dated January 21st, 1909, and March 16th, 1910, filed pursuant to Sec. 93 (3) of the Companies' (Consolidation) Act, 1908, the amount of the present issue being £100,000, ranking *pari passu* with £200,000 2nd debenture stock already issued. Property charged: The company's undertaking and property, present and future, including uncalled capital. Trustees: Metropolitan Trust Co., Ltd., 8, Crosby Square, E.C.

Sunbeam Lamp Co., Ltd.—Issue on March 23rd of £600 debentures, part of a series of which particulars have already been filed.

Pelaone Engine Co., Ltd.—Particulars of £1,200 debentures created March 22nd, 1910, filed pursuant to Sec. 93 (3) of the Companies' (Consolidation) Act, 1908, the whole amount being now issued. Property charged: The company's undertaking and property, present and future, including uncalled and unpaid capital. No trustees.

James Scott, Ltd. (99,868).—Particulars of £1,500 debentures, created March 4th, 1910, filed pursuant to Sec. 93 (3) of the Companies' (Consolidation) Act, 1908, the whole amount being now issued. Property charged: The company's undertaking and property. No trustees.

Leicestershire and Warwickshire Electric Power Syndicate, Ltd. (72,274).—This company's annual return was filed on March 29th, when 1,990 shares had been taken up out of a nominal capital of £20,000 in £10 shares. £10 per share called up on 1,470, and nil on 520. £17,740 paid (including payments in advance of calls); £40 remains in arrears. £20 12s. 1d. paid on 10 shares forfeited. Mortgages and charges: £2,250.

London Electric Supply Corporation, Ltd. (24,957).—This company's annual return was filed on March 18th, when 111,000 ordinary and 69,840 preferred shares had been taken up out of a nominal capital of £1,050,000 in 200,000 ordinary shares of £3 each and 90,000 preferred shares of £5 each. £682,360 paid, including £160 on 160 shares forfeited. Mortgages and charges: £387,355.

Electric Wiring and Fittings Co., Ltd. (29,676).—This company's annual return was filed on March 14th, when 1,682 shares had been taken up out of a nominal capital of £5,000 in £1 shares. £1,375 paid, leaving £7 in arrears. Mortgages and charges: Nil.

Rhymney Valley and General Electric Supply Co., Ltd. (89,413).—This company's annual return was filed on March 21st, when 2,101 shares were taken up out of a nominal capital of £5,000 in £1 shares (2,500 preferred). £1 per share called up on 930 ordinary, and 2s. per share on 354 preferred. £995 14s. paid, leaving £5 6s. in arrears. £817 considered as paid on 817 shares. £4 8s. paid on 80 forfeited preferred shares. Mortgages and charges: £900.

Waste Heat and Gas Electrical Generating Stations, Ltd. (91,238).—This company's annual return was filed on March 22nd, when 150,000 shares were taken up out of a nominal capital of £250,000 in £1 shares. £150,000 paid. Mortgages and charges: Nil. Return of allotments made up to March 19th shows a further 10,000 shares allotted for cash.

New Arc Lamp Syndicate, Ltd. (92,801).—This company's annual return was filed on February 14th, when 5,557 shares were taken up out of a nominal capital of £6,000 in £1 shares. £1,557 paid. £4,000 considered as paid. Mortgages and charges: Nil.

Vactite Wire Co., Ltd. (105,696).—Particulars of £3,000 debentures created November 18th, 1909, filed pursuant to Sec. 93 (3) of the Companies' (Consolidation) Act, 1908, the whole amount being now issued. Property charged: The company's plant, fixtures, stock and other assets. No trustees.

Trafford Power and Light Supply (1902), Ltd. (72,601).—Debenture dated March 30th, 1910, to secure £25,000, charged on the company's undertaking and property, present and future, including uncalled capital (if any). Holders: W. T. Glover & Co., Ltd., Trafford Park, Manchester.

Northallerton Electric Light and Power Co., Ltd. (59,301)—This company's annual return, made up to March 9th, has been filed. 1,151 preferred and 4,661 ordinary shares have been taken up out of a nominal capital of £6,500 in 2,900 preferred shares of £1 each and 12,000 ordinary shares of 6s. each. £2,519 6s. paid. Mortgages and charges: £5,400.

Atlas Carbon and Battery Co., Ltd. (34,857).—This company's annual return was filed on February 15th, when the entire capital of £3,000 in £1 shares had been taken up, £8 has been received and £1,992 is considered as paid. Mortgages and charges: £3,000.

Bude Electric Supply Co., Ltd. (95,137).—This company's annual return, made up to March 26th, has been filed. 4,773 shares have been taken up out of a nominal capital of £7,000 in £1 shares. £4,766 15s. 6d. has been received and £4 7s. 6d. remains in arrears. Mortgages and charges: £2,500 mortgage debentures.

Beck & Moss, Ltd. (69,298).—This company's annual return was filed on March 2nd, when the entire capital of £2,500 in £1 shares had been taken up. £525 has been received,and £1,975 is considered as paid. Mortgages and charges: £600.

Zodiac Publishing Co., Ltd.—Debenture dated March 24th, 1910, to secure £300, charged on the company's undertaking and property, present and future, including uncalled capital. Holders: Eastern Telegraph Co., Ltd., Electra House, Finsbury Pavement, E.C.

Turners & Manville, Ltd. (89,678).—This company's annual return was filed on March 1st, when 20,012 shares had been taken up out of a nominal capital of £50,000 in £1 shares. £10,621 paid. £9,391 considered as paid. Mortgages and charges: Nil.

Hastings and District Electric Tramways Co., Ltd. (82,521).—This company's annual return was filed on April 8th, when 40,000 preferred and 28,235 ordinary shares had been taken up out of a nominal capital of £500,000 in £5 shares (50,000 preferred). £5 per share has been called up on the preferred. £200,000 paid. £141,175 considered as paid on the ordinary. Mortgages and charges: £250,000.

Charing Cross, West End and City Electricity Supply Co., Ltd. (29,122).—This company's annual return was filed on March 24th, when 80,000 preferred, 80,000 ordinary, 80,000 City Undertaking preferred and 70,000 City Undertaking ordinary shares had been taken up out of a nominal capital of £2,100,000 in £5 shares (180,000 preferred, 139,000 ordinary, 80,000 City Undertaking ordinary and 80,000 City Undertaking preferred). £5 per share has been called up on 80,000 preferred, 80,000 ordinary and 80,000 City Undertaking preferred. £1,200,000 paid. £350.000 considered as paid on 70,000 City Undertaking ordinary shares. Mortgages and charges: £1,045,736.

CITY NOTES.

Trafford Power and Light Supply (1902), Ltd.

The directors' report for the year ending March 31st, 1909, states that the accounts show, after charging interest on the debenture stock, interest on loans, current expenses, debenture trustees' remuneration, and £2,000 for depreciation, a loss for the year of £2,516, as compared with a profit for the preceding year of £2,285. The depression in trade in the company's area, referred to in the previous year's report, has been widespread and severe. The sales of current have realised £13,867, as compared with £17,893 in the preceding year. The smaller output is due not to the number of consumers being reduced, but to the consumers requiring much less current. There is reason to believe that the lowest point has been reached, and that some contracts for new supplies recently entered into will materially increase the output. It is proposed to promptly create the 6 per cent. second debentures mentioned in previous reports, to the nominal amount of £40,000, of which £25,000 will be issued shortly to meet urgent requirements. As already advised, these debentures will be offered to the shareholders and debenture-holders for subscription, some of whom have undertaken to subscribe for a considerable proportion of the issue. The aggregate amount of the 4½ per cent. debenture stock of the company, purchased out of the debenture redemption fund and cancelled, amounted to £9,100 at the date of the previous balance-sheet, and £1,269 is now in the hands of the debenture trustees for further similar purchases. Since the last annual meeting the reduction of the company's share capital has been carried out with the sanction of the Court. An extraordinary general meeting will be held after the close of the ordinary general meeting for the purpose of passing the necessary resolution for the sub-division of the ordinary shares of the company into preference and ordinary shares.

Calcutta Tramways Co., Ltd.

The ordinary general meeting of shareholders of this company was held on Tuesday at 1, Queen Victoria Street, London, E.C., Mr. E. C. Morgan presiding.

The Chairman, in proposing the adoption of the report (see Electrical Review, p. 610), said it was very satisfactory to observe that, now that they had an entire year's working to deal with in Howrah, they found it had added slightly to the general net receipts, instead of showing a loss, as was the case last year. He might say that the working of this district continued to improve slowly and steadily, in spite of the competition which they still experienced from the ferries, and also without any assistance from the bridge, which appeared to be as far off as ever. After having placed during the year a further 912 preference shares, part of the 20,000 shares offered to the shareholders in 1907 remaining unissued, the amount overspent on capital account stood at £30,827, which had been temporarily met by the continuance of the loan from their bankers, which amounted to £32,500. This increase in capital expenditure was not due to new works undertaken during the year, but consisted almost entirely of payments made for the new car-shed, of which he made mention a year ago, and for the line—about ½ mile—which connected it with their Calcutta system. This was proving a most judicious expenditure, which had not only placed them in a position to deal with their cars, but was also relieving the serious congestion of the traffic, from which they had been suffering at the Sealdah station. Coming to the revenue account, it was satisfactory to note that savings had been effected under all heads, except in the case of maintenance and repair of cars and their equipment. The heavy expenditure under this head was due to the circumstances mentioned last year as to the difficulties experienced through want of space, which had caused much work to fall into arrear, and also, to some extent, to the greater number of cars in service, but that has been largely removed by the new car-shed. The cars constituted an item of expenditure which would always be heavy in their undertaking, as the destructive qualities of the Calcutta climate rendered more frequent overhaul of their vehicles necessary than was the case elsewhere, in order to keep them in good condition. They could not expect much diminution in expenditure in this direction, as constant attention to the cars was absolutely needed, and, with expanding traffic, there were more cars in service which required attention. There had been a considerable reduction in fuel costs of about £1,000, which was very satisfactory, especially in view of the fact that during the year under review, they had been paying a price for their coal equal to 10 per cent. in excess of that paid in 1908. On the credit side of the account, it was very encouraging to observe the large increase in traffic receipts of nearly £9,000, the figure being £174,367. Last year, when conditions were very unfavourable, they experienced a slight set-back in receipts, as compared with 1907, but this had been more than recovered, and the year 1909 was the best they had yet had. Perhaps, though the were only dealing with last year's figures, he might be allowed to say that during the present year, their returns gave promise of a substantial increase on those of 1909. The present position of the undertaking was, in their opinion, both sound and progressive. They had passed through very difficult times, largely in consequence of their extensions, not so much by reason of the extensions themselves, as in consequence of the delays to which they had been subjected in carrying them out. These had put a heavy strain upon their original system, as it was necessary to raise large sums of money to complete the works, which remained a dead weight upon their earnings from the old lines until it was possible to open the new ones. It was, therefore, a matter of great congratulation to find that when the opening was possible, it was found that the cost of construction was fully justified. Howrah, it was true, was still lagging behind, due to causes beyond their control, but it would not be long, they believed, before it became a valuable auxiliary. The line through Alipore, however, was already one of the best in the system, and that to Behala was growing in value, and they had already had numerous applications to extend further to the southward. This district was likely to become in the early future a much more important residential quarter when the extension of the docks in that direction became more defined. It might be remembered that their original scheme of extensions comprised one towards the north to Barnagore, but at the last moment the principal authorities declined to accede to this, save on conditions which were prohibitory, so that their capital expenditure had practically come to an end. The conditions in Calcutta at the present time were decidedly good. Trade was better, and crops had been abundant, so there was good ground for looking forward to the maintenance of the improvement indicated by the returns so far to hand during the current year.

Sir Henry Kimber, Bt., M.P., seconded the motion.

Replying to a Shareholder, the Chairman said he would not go the length of saying that their capital expenditure had absolutely finished, because they did not know what might happen in the future. As far as he could see, however, they had no immediate intention to increase the capital. It would, of course, be necessary to provide for the amount already expended, from which they were getting returns.

The report was adopted.

The Chairman proposed a vote of thanks to the manager and staff in Calcutta. He remarked that the company was very ably served in that city by a staff which had its heart in the business. Although, no doubt, they heard complaints, the shareholders could judge how much truth there was in them from the fact that the traffic was growing every day. If the cars were in the tumble-down condition that they were represented to be by some people who wrote to the Calcutta papers, they would not be able to increase their traffic as they were doing. Their knowledge of the business from the inside was that it was exceedingly well conducted.

Sir H. Kimber seconded the resolution, and it was carried, and a vote of thanks to the Chairman and the board terminated the proceedings.

Altrincham Electric Supply, Ltd.

The directors, in their report for the year ending December 31st, 1909, states that during the year 108 installations, representing 3,809 equivalent 8-c.p. lamps, have been connected to the mains; after allowing for disconnections in 1909 and previous years, there were on December 31st, 1909, 1,080 actual consumers with 62,470 equivalent 8-c.p. lamps. In progress there are 27 installations with 838 equivalent 8-c.p. lamps. The income derived from the sale of current during the year shows a further reduction of about 3 per cent. when compared with the preceding year. The results of the latter half of 1909 point, however, to the probability that this decline is now coming to an end.

After providing £1,709 for interest on loans and debentures and adding £1,610 to reserves for depreciation, the net profit for the year is £2,071, plus £55 brought forward. The directors recommend that a dividend of 7 per cent. be declared on the shares, which will absorb the sum of £1,750, leaving a balance of £376 to be carried forward, subject to provision for directors' fees. The directors regret the loss by death of their colleague, Mr. H. Wolfenden, jun. They have elected Mr. William Murray to fill the vacancy. Sir Joseph Wilson Swan, D.Sc., F.R.S., has resigned his seat on the board. Mr. H. Wolfenden offers himself for re-election.

Lisbon Electric Tramways, Ltd.

The directors' report for the year ending December 31st, 1909, says that the result of the operations for the year, after deducting interest and amortisation due on the debentures of the "Companhia Carris de Ferro de Lisboa"; and after the payment of £25,585 for interest on and redemption of the debentures of this company, and also for the payment of London office expenses and directors' remuneration, shows a net profit of £103,766, which, added to the amount of £3,380 brought forward from last year, gives a balance of £107,146. From this amount, £35,000 has been placed to depreciation reserve, and the sum of £5,000 to the credit of exchange reserve account. The directors have also set aside £5,000 to be separately invested as a nucleus for the future establishment of an employés' pension fund. The directors have further considered it advisable to write down investments of the company to market value as at December 31st, 1909, and have charged depreciation reserve account with the amount. After providing for the above, there remains an available balance of £62,146, out of which the usual preference dividend, amounting to £25,533, has been paid. On October 12th, 1909, the directors paid on the ordinary share capital an interim dividend of 2½ per cent. net, amounting to £15,851, and they now recommend the payment of a final dividend of 3 per cent. net, amounting to £19,021, making 5½ per cent. for the year 1909. The balance of £1,742 remaining to the credit of the profit and loss account, has been carried forward. The traffic operations of the company continue satisfactory, and show a steady increase on the year 1908. The rate of exchange has remained at very nearly the same level as in the previous year. The further issue of 3,310 ordinary shares has been made in connection with the purchase of an additional interest in the "Nova Companhia dos Ascensores Mechanicos de Lisboa." The directors again record the valuable services rendered to the company by the members of the local board in Lisbon, by Mr. William Clark, the general manager, and by the entire staff.

Babcock & Wilcox, Ltd.

The report for the year ended December 31st, 1909, shows a net profit of £360,004, plus £43,279 brought forward, making a balance of £403,283. After deducting the interim dividends paid October 11th of 3 per cent. on the preference shares, and of 8 per cent. on the ordinary shares, amounting to £69,400 there is a balance of £333,883 from which the directors recommend that the following dividends be paid for the half-year ending December 31st, 1909, viz.:—Dividend 3 per cent. on the preference shares (from which income-tax is to be deducted) £3,000, dividend of 8 per cent. on the ordinary shares (free of income-tax) £66,400, and a bonus of 8 per cent. on the ordinary shares (free of income-tax) £66,400. Placing to reserve fund £100,000 (which will bring this fund up to £600,000), placing to the dividend equalisation fund £25,000 (which will bring this fund up to £220,000), placing to a staff pension fund £10,000, and leaving a balance to be carried forward of £63,083. Although the sales during 1909 did not show much improvement compared with the previous year, the year's trading was beneficially affected by some older large contracts which during 1909 came into the accounts. The companies with which the company are connected gave them increased returns. The cost of production of certain of the manufactures was also reduced during the year by improvements in machinery and organisation. These factors having increased the profit as compared with last year, the directors consider that they are justified in suggesting the distribution out of the profits of 1909 of a somewhat larger bonus. The company's works have been well maintained. The business in boilers for marine purposes, both naval and mercantile, is progressing. The directors commend to shareholders' approval the creation of a staff pension fund. Many other large firms have adopted this policy.

North Metropolitan Electric Power Supply Co., Ltd.

The ordinary general meeting of the shareholders of this company was held on Thursday of last week at Electrical Federation Offices, Kingsway, Mr. E. Garcke presiding.

The Chairman, in proposing the adoption of the report (see Electrical Review, page 612), said that the amount of energy sold during the year was 16,402,000 Board of Trade units, which was an increase of 16½ per cent. upon the preceding year. The total revenue from the sale of current amounted to £87,800, which showed a corresponding increase. In order to provide for this additional output, an increased expenditure necessarily must be expected, but it was very satisfactory to note that the expenses were only £1,290 in excess of the previous year, or an increase equivalent to less than 4 per cent. The capital expenditure of the year had been incurred principally for additional machinery at the Willesden power station, for the equipment of sub-stations throughout the area of supply, and for additional mains. Since the closing of the books they had issued a further £25,000 preference shares, and debentures amounting to £23,000. At the present time the capital issued was £100,000 preference stock, and £150,000 mortgage debentures, in addition to the £350,000 of ordinary shares. The business of the company was developing very satisfactorily. In addition to supplying electrical energy for the tramways and light railways the company was working the electric lighting orders of the Tottenham and Edmonton Councils, and was selling electricity in bulk to the Stoke Newington and Willesden Councils and the Hendon electric supply company for the purposes of their respective lighting orders, and also to the North Metropolitan Electric Power Distribution Co., for their electric lighting undertaking in Enfield, Barnet, Hertford and St. Albans. Electricity was also being supplied to an increasing number of power consumers. The agreement with the Willesden Council had been extended until 1918, and the increase in power consumers was quite satisfactory, being more than 70 per cent. during the year. Altogether the indications of manufacturers availing themselves of the cheap power supply which the company was able to give in the metropolitan area was quite satisfactory. Speaking of a cheap power supply, he thought it would be satisfactory to the shareholders to be told that having regard to the cost of fuel in the metropolitan area and to the output of the company, he believed that the costs of generation and distribution of the company were among the lowest in the country.

Sir Ernest Spencer seconded the motion, and the report was adopted.

Mr. Garcke was re-elected a director.

Merthyr Electric Traction and Lighting Co., Ltd.—The meeting of this company was held in London on 15th inst., Mr. G. J. Somerville presiding. An abstract of the report appeared in our last issue. The chairman referred to the unsettled state of the coal trade in South Wales recently, and said that the report must be considered satisfactory. The time had come when £2,241 might be taken from the reserve account and applied to writing off discounts on debenture stock. The company had undertaken public lighting at Dowlais. They thought it best to adopt overhead wires. The scheme was opposed by certain people, but he thought the Board of Trade would, as the result of the inquiry held, sanction the scheme. The traction receipts showed a decrease. Cyfarthfa Park was now open to the public. The Merthyr Corporation had taken energetic action against the company with regard to overcrowding on the cars. It was impossible to prevent overcrowding at times, but with the approval of the Corporation the company had obtained power to run double-deck cars. Three were on already, and others would be converted in time for the Whitsun holidays. Cefn Bridge was constructed at last, and arrangements had been made for laying a tramline across it. This would necessitate an application for fresh capital.

Cuba Submarine Telegraph Co., Ltd.—The report of the directors for the half-year ending December 31st, 1909, says that the total receipts of the six months were £16,377, while the expenses amounted to £6,415, leaving a balance of £9,962, to which has to be added £7,059 brought forward, giving a total of £17,021 to be dealt with; £2,000 has been added to the reserve fund, which now stands at £116,000. The dividend on the preference shares will absorb £3,000, and leave £12,021, out of which the directors recommend the payment of a dividend at the rate of 6 per cent. per annum on the ordinary shares, free of income-tax, £7,221 being carried forward. The cables continue in good working order. Mr. Charles Woodbyne Parish having expressed a desire to resign the chairmanship, Mr. George Keith has been appointed chairman, but Mr. Parish retains his seat on the board.

Germany.—The balance-sheet of the Deutsche Kabelwerke Gesellschaft, of Berlin and Rummelsburg, for the last financial year shows a net profit of £23,712, as contrasted with only £20,107 in the preceding 12 months. The dividend is being increased from 6 to 7 per cent.

British Columbia Electric Railway Co.—An interim dividend at the rate of 8 per cent. per annum on the deferred ordinary stock is announced.

Bell's Asbestos Co., Ltd.—A dividend of 1s. 6d. per share, making 12½ per cent. for the year is announced.

Stock Exchange Notices.—The following are to be quoted in the Official List:—Rio de Janeiro Tramway Light and Power Co., Ltd.—Further issue of £350,000 5 per cent. 50-year mortage bonds, Nos. B 14,001 to B 17,500 of £100 each.

Montreal Light, Heat and Power Co.—A dividend of 1¾ per cent. on the paid-up capital stock, being at the rate of 7 per cent. per annum, has been declared for the quarter to the 30th inst.

Monte Video Telephone Co., Ltd.—An interim dividend for the half-year ended January 31st at the rate of 6 per cent. per annum on the ordinary shares has been declared.

Cork Electric Tramways and Lighting Co., Ltd.—This company held its annual meeting at 83, Cannon Street, E.C., last week. Mr. A. R. Monks, in moving the adoption of the report (see Electrical Review, April 15th), said that the company were employing a special staff to advise lighting and power consumers and to inspect installations during erection. The report was adopted.

Prospectus.—*British Aluminium Co., Ltd.*—This company has this week been offering for subscription an issue of £800,000 5 per cent. prior lien debentures at 97.

London United Tramways, Ltd.

The directors' report for the year ending December 31st, 1909, says that the operations during that period resulted in gross receipts amounting to £318,226, and the working and general expenses, maintenance and repairs, to £226,567, leaving, with the balance brought forward, a net revenue of £91,986. After payment of interest on debenture stock and loans for the year, and providing for income-tax, there remains a balance of £21,950. Of this amount the directors propose placing £21,000 to reserve fund for renewals and to carry the balance of £950 forward. With the amount now added the reserve funds will total £52,368. The gross receipts show a decrease of £30,164, and the working expenses an increase of £6,335, resulting in a decrease of £36,498 in the net revenue as compared with the preceding year. The decrease in traffic receipts was principally caused by the extremely unfavourable weather experienced during the whole of the summer months of last year, which seriously affected the pleasure traffic, and by the competition of other transportation companies in the most remunerative districts of the undertaking. The increase in working expenses is chiefly due to the additional repairs to permanent way and rolling stock, but on the other hand a considerable saving has been effected in the cost of electric current owing to the reduced price of coal during last year. The directors have carefully considered the condition of the permanent way and rolling stock, and they deem it advisable from the standpoints of both economy and efficiency that certain repairs which have become necessary should be undertaken immediately. They, therefore, propose to forego payment of any dividend on the preference shares for the past year, and to utilise the reserve funds for the purpose of these repairs. The company's Bill for obtaining powers to postpone the period for the acquisition by the London County Council of the portion of the undertaking within the Borough of Hammersmith did not receive the sanction of Parliament. The directors are giving this important matter their most careful consideration. The directors have deposited a Bill in Parliament to extend the period for the reconstruction for electric traction of the tramway along the Kew Road, Richmond. Sir Clifton Robinson having resigned the position of managing director and engineer, Mr. A. H. Stanley has been appointed to succeed him as managing director, and in accordance with the company's articles of association, now offers himself for re-election. Mr. W. H. Brown, the director retiring by rotation, also offers himself for re-election. Mr. James R. Chapman having returned to the United States, has resigned his seat on the board.

Oriental Telephone and Electric Co., Ltd.

The directors' report for the year ended December 31st last states that including £5,263 brought forward, and after deducting the interim dividends of 3 per cent., paid November 1st last, on both the preference and ordinary shares, and making the necessary provision for redemption of the debenture stock of the company, and other charges as shown in the net revenue account, the amount to be dealt with is £18,994. The directors recommend that this sum be appropriated as follows, viz.: Final dividend of 3 per cent. (less income-tax) for the year on the preference shares issued, £1,500, a final dividend of 5 per cent. (free of income-tax) on the ordinary shares issued, making 8 per cent. for the year, £8,966, transfer to reserve account £7,500, to reserve for contemplated pension scheme £500, carrying forward £10,529. The exchanges worked by the company continue to show improving revenues. In Mauritius negotiations are still proceeding with the Government with a view to enlarge the field of the company's operations in the island. The Indian local companies report a continued accession of subscribers to their exchanges. The Bengal Telephone Co., Ltd., has declared the same dividend as for the year 1908, viz., 5 per cent., and the Bombay Telephone Co., Ltd., 7 per cent. (as against 6 per cent. for 1908), and the amounts have been included in the revenue account. The Telephone Co. of Egypt, Ltd., has also shown further increases of business during 1909. That company has again declared a dividend of 10 per cent. for the year on both its preferred and deferred shares, which has been brought into the account. The China and Japan Telephone and Electric Co., Ltd., also made good progress during last year both at Hong Kong and Kowloon, and dividends of 5 per cent. both for 1908 and 1909 have been declared and included in the revenue account. The directors in July last issued the remaining £50,000 4 per cent. redeemable debenture stock, being the balance of the authorised total issue of £200,000, the whole of which is now quoted on the London Stock Exchange.

La Plata Electric Tramways, Ltd.

The directors' report for the period from the date of incorporation of the company to December 31st, 1909, states that the result of working shows, after providing for debenture stock interest, a debit to revenue account of £151. During this period the tramways were worked wholly by horse traction, the inauguration of the first section (about three miles in length) under electric traction having taken place on January 4th of the current year. The following is a comparison of the traffics for the 12 months ended December 31st, 1909, with those for the same period ended December 31st, 1908:—

	Miles run.	Passengers carried, exclusive of holders of monthly passes.	Receipts in currency.
1909 ...	663,793	2,141,641	$256,628.10
1908 ...	679,001	2,105,420	251,236.50

The total receipts as cabled for the first three months of the current year were £7,100, of which £1,926 was derived from electric traction. This figure of £7,100 compares with £5,947 for the corresponding period of 1909. The preference dividend to December 31st, 1909, at the rate of 6 per cent. per annum, was paid on April 1st, 1910, in accordance with the guarantee of La Plata Syndicate, Ltd. It is expected that the electrification of the system will be completed in January, 1911.

The first annual general meeting was held on Tuesday at the offices, 52, Moorgate Street, Mr. W. F. Hamilton, K.C., in the chair.

The Chairman, in proposing the adoption of the above report, said it would not interest the shareholders for him to go into detail into the figures of the working account which had been submitted, as they represented a year of working solely by horse traction. The expenses, so far as concerned the maintenance items, were naturally less than they would have been if it had been necessary to maintain the old lines and the old rolling stock for a continuance of horse traction. On the other hand, the receipts, showing as they did an increase upon those of the previous year, would have been greater still if it had not been for the interruptions to traffic caused by the work of reconstruction during the year. The electrification of the first section of the tramways, comprising slightly over three miles of single track, was completed for traffic at the beginning of this year, and the inauguration took place on January 3rd, when the Governor of the Province acted as the company's first motorman, and subsequently made a highly complimentary speech as to the action of the company and the admirable work done. He ought to say that they had received every assistance from the Government in facilitating their working, and that their relations with them were very cordial. They had been informed by a recent cablegram that the second section, comprising 5½ miles of single track, was open for traffic on the 7th of this month. The traffic receipts for the first 15 days of this month, which comprised eight days electrical working of the second section, showed a total of £1,420, of which £614 was derived from electric traction, an increase of total receipts for that period of £380. The aggregate increase since the beginning of the year was £1,533. Those two sections comprised most of the principal lines in the city, as they connected the railway station with the principal public buildings, such as the Government offices, banks, &c. Section three comprised the branches to the park, the museum and the racecourse. He (the chairman) had been to La Plata, and the shareholders might be interested in knowing that in his opinion the park was one of the prettiest he had ever seen in that part of the world, and that the museum which was in the park contained a larger collection of skeletons of antediluvian animals than was to be found in any part of the world. Speaking also from his experience of Buenos Ayres, he knew that a very profitable part of the tramway line in Argentina was that part which led to the racecourse. They expected good results from that third section. The remaining sections were what he might call suburban sections—they were the extensions to Los Hornos, to the cemetery, to Tolosa and Ensenada. Perhaps he ought not to call the latter a suburban extension, as Ensenada was a port of La Plata. It was, moreover, an important and a growing port, and he hoped that in the near future they would have a considerable traffic going on between Ensenada and La Plata. Excluding the Ensenada branch, they were informed that the whole of the work should be finished in October next. As regarded the Ensenada section, that was a line mainly within national territory, and the company's concession had to that extent to be ratified by the national authorities, and the necessary application had been made. Although the formal ratification had not been received, they were advised that there would be no opposition to their proceeding with the work. If the necessary authority was obtained in time to enable them to proceed with the line to Ensenada in October, the whole of the work should be completed during January next year, so that at the beginning of their financial year they would contemplate a complete year worked solely by electric traction. The results of the working by electrical traction, so far as they were at present known, were satisfactory. Down to the end of the last return the receipts from the three cars which were running electrically on the first section gave an average of 1s. 3d. per car-mile run, or just about double the receipts per car-mile obtained over the whole system under horse traction during the corresponding period of 1909. The consumption of power was, all things considered, satisfactory, being slightly over 1 unit per car-mile run. They had made arrangements by which they would defer making a further call upon the preference shares at present. The revenue account showed a debit balance of £150 11s., and, consequently, the guarantors of the preference dividend had paid the amount on the preference shares for the past year. His colleague, Mr. Western, was in the Argentine last year, and paid several visits to the property, and discussed several matters with the local director and the manager. He (the chairman) proposed to visit La Plata this year on the company's business. He was glad to say that the prospect of things in the country generally were very favourable, and as soon as they had passed the transition stage of concurrent working by horse and electric traction, they hoped to show satisfactory results.

Mr. W. T. Western seconded the motion.

Mr. J. C. Lyall asked whether there was any prospect of the company being absorbed by a German company which was taking over several of the electric companies in the Argentine.

The Chairman replied that he had not heard of any such absorption.

The report was then adopted.

Metropolitan Electric Tramways, Ltd.

Mr. E. Garcke (chairman) presided on Thursday last week at the Electrical Federation Offices, Kingsway, W.C., over the ordinary general meeting of the above company.

In moving the adoption of the report (see Electrical Review, page 613), the Chairman said the tribulations of tramway companies in this country were so great and so well known, that no doubt the shareholders in this company had some difficulty in believing that the position was satisfactory, that the prospects were good, and that the payment of 5 per cent. on the ordinary shares was compatible with the maintenance of the property and the adequate provision for depreciation. But, nevertheless, such were the facts, as he would be able to show. The primary reason of this contentment and absence from oppressive anxiety was undoubtedly the arrangement which they were able to make with the local authorities, and which the late Sir R. Littler described as an exceedingly statesmanlike arrangement. It was an arrangement which made the desires and objects of the local authorities, as owners of the light railways, compatible with the necessary requirements of the operating company. It was, in short, an arrangement which gave fair-play between all parties, and it was this which had a very important bearing upon the net results produced by the company. It enabled them to maintain a contented and efficient staff of officials, who were able to devote the whole of their energies to the development of the business of the company. With the extensions which they opened in the past year they had practically completed this important system of tramways and light railways in the North Metropolitan area, and the present, therefore, was a convenient occasion for calling attention to the area which the company served. They had developed this important business unostentatiously, and he believed there were many people who did not realise what an important change had taken place in the transit facilities of the north of London. Those who knew that area 10 or 12 years ago were aware that it was very difficult to reach the various points, but there was now scarcely a country lane in that vast area which was not quickly and easily reached by means of the tube railways from the centre of London and the continuous service provided by the tramways. Obviously these tube railways were of great advantage to them, but the advantage was just as great to the tube railways. Since their tramways along the Finchley Road were opened the traffic to the Golder's Green Tube had been practically doubled. Some of the shareholders looked on the tramways as being in the form of a small provincial tramway, but they worked altogether 51 miles, which was a by-no-means small proportion of the total tramways worked in the metropolitan area. They had powers for a small tramway at Watford, which was still under consideration, and they had small connecting links at Enfield to Ponder's End and in the Harrow Road to make, so that he might say the system was practically complete, and, at any rate, for the immediate future they might consider the capital account closed. It had been a very difficult business to build up an enterprise of that kind requiring a large capital, and with the issue of £250,000 second debentures quite recently, he was happy to say they felt relieved of further financial anxiety until some new development took place, because, of course, one could not speak of the indefinite future. Criticism had been made in a financial paper to the effect that the company was over-capitalised, and that its finances had not been satisfactorily conducted, and as some shareholders might have been misled, he would like to give the figures. The total capital which had been expended on the combined tramways, light railways and electric power supply amounted to £3,760,000, and the total amount paid during the period of building up for promotion expenses, costs of finance and preliminary expenses of all kinds amounted to a figure which represented 6 per cent. on the total capital expenditure of the combined undertakings of the company. He left them to judge whether the concern had been over-capitalised or its finances badly conducted. These figures took into account £314,000 of deferred shares, which did not represent capital expenditure of the company, but merely expressed an equitable arrangement between certain classes of shareholders when the horse tramways of the old North Metropolitan Tramways Co. was taken over. The increase in power consumers was quite satisfactory, amounting to something like 70 per cent., in the past year, and as the district developed he had not the slightest doubt but what the business of the Power Co. would steadily increase. They had received a dividend of 6 per cent. on their shares in that company against 5 per cent. in the preceding year. He had gone so fully into the tramway figures on previous occasions that he thought there was no necessity to detain them with regard to these. He would only say they proposed to pay a dividend of 5 per cent. on the ordinary shares as compared with 4½ per cent. last year. This required £19,566, and the dividend on the preference shares required £25,000, so that the total sum required for the payment of the dividend was £44,566. They would probably like to have in juxtaposition to that figure the amount which they were putting aside for renewals, reserve and similar purposes, and it was £37,858. He thought he was expressing the opinion of the board and the management when he said that if they were allowed to carry on the enterprise as business people without interference, they had every confidence that they had a thoroughly satisfactory, prosperous and remunerative undertaking. In conclusion, he would like to bear testimony to the very valuable services rendered by the able staff. The all knew Mr. Devonshire, the managing director, and the directors valued very highly the services he rendered. He was assisted by a staff of very indefatigable workers in Mr. Pott, the managing engineer; Mr. Murray, the engineer of the Power Co.; Mr. Barber, the secretary; Mr. Boys, the secretary of the Power Co.; Mr. Hammond, the traffic superintendent, and all the other various assistants right down to the lowest. They all worked hard to make the company a success.

Sir Ernest Spencer seconded the motion.

Mr. Ennis observed that he had keenly watched the struggle of the board under adverse circumstances to bring the enterprise to fruition, and there seemed to be evidence that they had almost arrived at that stage. At the risk of seeming a little ungracious, he asked why the board had rushed to pay the extra ½ per cent. He considered a true conservative policy would have been to have kept that money in hand. He would also like an explanation of the item £1,528 in the profit and loss account for salaries charged to capital. It was an unusual item.

Mr. Wyatt pointed out that the rates of working charges in the last few years had steadily increased. In 1905 it was 59 per cent.; in 1906, 65 per cent.; in 1907, 67 per cent.; 1908, 71 per cent.; and 1909, 72 per cent.; or an increase of 13 per cent. in five years. At the same time the average receipts per car-mile were steadily decreasing. In 1907 it was 11·63d.; in 1908, 11·32d.; and in 1909, 11·13d. He was very glad indeed to hear that the extensions had ceased; for he thought they had enough to go on with, and to pay well on. He had in his mind another company which started with quite as good prospects as they had, and now the shares were about 75 per cent. below their par value. He could not also help feeling a little nervous about the considerable extra sum which would have to be paid in the next year on the debentures, and also the sinking fund which was to start in 1912.

The Chairman said he agreed that in the ordinary way the item which Mr. Ennis had referred to would not be a nice one, but it was necessary for their interests that they should have it. It represented a fair proportion of the time spent on new work during the past year. When the Middlesex County Council did new work for the company they charged a fair proportion of staff salaries. The County Council was entitled to interest on the money they spent in new works, and the company were equally entitled to interest on the money they spent in new works. Therefore, if they did not charge a fair capital expenditure they would suffer in interest in the joint account with the County Council. The directors felt that the dividend could be increased without any risk of having to go back. Mr. Wyatt's criticism touched the essential spots, but he could not quite reconcile the figures. He did not know how Mr. Wyatt had arrived at his figures, but he presumed he had taken into account the ever increasing provision which they were making for renewals of the permanent way. In the early years they did not make very large provision, and consequently the percentage would be lower. But even including the provision for renewals, he found that in 1908 and 1909, the percentage of working expenses to receipts was the same in both years, viz., 67 per cent., which, considering the character of the undertaking and the necessity of keeping the rolling stock and permanent way in a high state of efficiency, was not a very high percentage. As to the receipts per car-mile going down, that must be expected, because in the early years they were serving only densely populated districts. The board had been congratulating themselves that the reduction was not greater than it was. Whilst they hoped that further extensions had ceased, yet it must be remembered that in this they had to consider the wishes of the Middlesex and Hertford County Councils, and it was here that the enormous benefit of the arrangement they had made with those bodies came in; because if the Councils wished to develop districts, which the company did not think they were justified in doing, then it could only be done at the risk of the local bodies receiving less profit than they had received. He was glad to say that the district opened up showed evidence of the traffic developing. Last year the increase in receipts amounted to £26,000, and from January 1st to date the increase already amounted to £21,000.

The report was then adopted unanimously, and the retiring directors were re-elected.

Canadian General Electric Co.—In their report for 1909, the directors state that the profit and loss statement, while showing that the dividend for the year has been earned, does not reflect the actual measure of the prosperity of the company at the end of the year. Owing to the financial and industrial depression existing in 1908 and extending well into 1909, the first half of the financial year showed discouraging results because of insufficient manufacturing orders to keep the various departments of the works operating on an economical basis. The latter part of the year, however, showed decided improvement, and since the close of the year the marked improvement in volume of orders received has been maintained. The company, it is stated, has secured some of the most important contracts for electrical apparatus ever awarded in any country, totalling nearly 200,000 H.P. These include three generators of 15,000 H.P. each, three generators of 12,500 H.P. each, and two of 11,000 H.P. each. The company's subsidiary—the Canada Foundry Co.—has all departments now back to normal production, the structural steel department being overtaxed. The great development of the Canadian North-West made it increasingly difficult to handle the business of that district from either the Vancouver or Winnipeg branches, and the directors arranged to open a new branch office in Calgary, Alberta, which is now in operation. The profit for the year, after providing $91,093 for depreciation, $51,660 interest on borrowed capital, and $469,000 dividends paid (7 per cent.), amounted to $14,236, which, with the undivided profits from 1908 of $145,231, give a balance at credit of profit and loss account of $159,466.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Fortnight ended	Receipts for the fortnight. £	Receipts for the fortnight. £*	No. of wks.	Total to date. £	Total to date. £*	Route miles open.	Inc.
Aberdeen	April 13	2,514	— 95	45	61,182	— 687	..	..
Ayr	,, 16	407	— 109	48	13,388	— 76	8	..
Bath	,, 16	1,401	— 334	15	10,491	+ 1,183	..	..
Belfast	,, 15	7,520	— 543	2	8,072	— 458	37	..
Birkenhead	,, 17	2,027	— 110	2	2,432	— 270	18·63	..
Birmingham Corp.	,, 9	13,859	+ 649	1⅔	8,449	— 1,328	56·46	..
Blackburn	,, 13	1,876	—1,137	2⅔	3,165	— 514	14·12	..
Blackpool Corp.	,, 14	1,126	—1,854	2	1,126	— 1,800	..	..
Blackpool-Fleetw'd	,, 16	606	— 972	15	4,775	+ 45	..	..
Bolton	,, 10	4,506	—1,047	2	3,094	— 1,506	26	..
Bournemouth	,, 13	3,075	— 856	1⅔	2,816	— 1,115	21·96	..
Bradford	,, 16	9,228	—1,486	3	10,849	— 2,047	54·81	..
Brighton	,, 17	1,637	— 488	2⅔	1,990	— 584	9·5	..
Bristol	,, 15	10,872	—1,239	..	..	..	..	..
Brit. Elec. Trac. Co.								
Airdrie	,, 8	434	+ 25	14	3,017	+ 101	3·65	..
Barnsley	,, 8	867	+ 18	,,	2,338	+ 148	..	..
Barrow	,, 8	480	+ 142	,,	3,169	+ 376	5·37	..
Cavehill	,, 8	351	+ 234	,,	1,017	+ 258	..	..
Devonport	,, 8	891	+ 136	,,	5,646	+ 597	8·85	..
Gateshead	,, 8	1,960	— 43	,,	13,354	— 48	11·25	..
Gravesend	,, 8	438	+ 61	,,	2,641	+ 219	6·5	..
Greenock	,, 8	1,282	+ 249	,,	7,382	+ 1,119	7·25	..
Hartlepool	,, 8	463	+ 90	,,	2,881	+ 167	6·72	..
Kidderminster	,, 8	242	+ 69	,,	1,212	+ 113	..	..
Leamington	,, 8	372	+ 25	,,	2,032	+ 80	..	..
Merthyr	,, 8	466	+ 23	,,	2,681	— 53	2·9	..
Metropolitan	,, 8	15,706	+3,272	,,	94,578	+20,802	22	..
Middleton	,, 8	746	+ 18	,,	3,895	— 188	8·5	..
Mid. Joint Com'tee	,, 8	12,329	+1,126	,,	76,591	+ 4,079	..	..
Oldham—Ashton	,, 8	1,266	+ 40	,,	7,409	+ 114	9·18	..
Peterborough	,, 8	233	— 18	,,	1,384	+ 42	5·31	..
Potteries	,, 8	3,474	— 158	,,	23,710	— 238	29	..
Rothesay	,, 8	442	+ 289	,,	973	+ 816	2·75	..
Southport	,, 8	690	+ 179	,,	3,363	+ 327	3·17	..
S. Metropolitan	,, 8	1,740	+ 108	,,	10,198	— 1,081	..	..
Swansea	,, 8	2,127	+ 304	,,	13,674	+ 1,663	13·5	..
Tynemouth	,, 8	471	+ 131	,,	2,169	+ 398	3·75	..
Weston-s-Mare	,, 8	242	+ 150	,,	547	+ 170	8	..
†Worcester	,, 8	590	+ 57	,,	3,377	+ 192	5·75	..
Wrexham	,, 8	219	+ 6	,,	1,265	+ 81	..	..
Yorks. Wool. Dist.	,, 8	2,154	+ 423	,,	13,045	+ 1,587	17	..
Miscellaneous	,, 8	461	+ 70	,,	2,693	+ 229	..	..
Burnley	,, 16	2,372	— 572	..	..	..	..	..
Burton-on-Trent	,, 17	502	— 50	2½	604	— 60	6·62	..
Bury	,, 17	2,200	+ 574	2⅔	2,715	— 729	22·5	..
Cardiff	,, 9	4,313	+ 76	2	2,655	— 597	..	..
†Carlisle	,, 12	155	+ 15	10	1,491	+ 45	..	..
Chatham and Dist.	,, 14	1,814	+ 245	14	10,670	+ 1,103	14·98	..
Cork	,, 14	925	— 56	..	6,517	+ 255	9·89	..
Croydon	,, 1	3,700	+1,045	..	..	..	..	..
Darlington	,, 16	352	— 89	3	557	— 16	..	..
Darwen	,, 15	445	— 141	2	472	— 167	4·36	..
Dover	,, 9	333	— 43	..	..	..	4·75	..
Dublin	,, 15	10,136	— 342	..	75,554	+ 3,178	54·25	..
Dundee	,, 13	2,355	— 69	47⅔	55,940	— 573	15·5	..
East Ham	,, 16	1,933	— 138	2⅔	2,247	— 125	8·52	·77
Exeter	,, 15	576	— 148	2	629	— 181	5·5	..
Glasgow	,, 16	34,776	— 102	..	776,584	+ 2,223	96·25	3·62
Hastings	,, 14	1,700	— 806	..	..	..	..	..
Huddersfield	,, 9	4,914	+ 686	..	..	..	28·5	·5
Hull	,, 16	5,207	— 73	2	6,065	— 438	14·5	·5
Ilkeston	,, 14	264	— 38	2	213	— 87	..	..
Ipswich	,, 16	707	— 141	2	813	— 121	10·5	..
Kilmarnock	,, 16	279	— 11	48	6,941	— 196	4·25	..
Lancashire United	,, 13	2,266	—1,218	..	18,287	— 67	39	..
Leeds	,, 16	13,103	—1,077	2	15,329	— 548	..	..
Leicester	.. ..	..	..	..	..	..	..	..
Leith	,, 9	1,147	— 149	47½	27,730	+ 3,355	9	2
Liverpool	,, 9	21,567	+ 203	14⅓	149,824	+ 4,177	113·5	6
†L.C.C.	,, 2	80,976	+18,196	..	1,979,888	+187,498	132½	10·5
London United	,, 16	11,325	—2,499	..	79,031	+ 8,115	..	..
Lowestoft	Mar. 6	102	+ 26	23	3,258	+ 220	8·5	..
Manchester	April 16	28,705	+2,944	2	34,413	— 2,591	183	1
Newcastle	,, 16	7,312	—1,090	..	8,567	..	14·5	..
Newport	,, 9	1,361	— 216	2	1,361	+ 17	14·5	..
Oldham	,, 17	3,399	+ 999	3	6,416	+ 796	23·75	..
Pontypridd	.. ..	..	..	..	..	..	..	..
Portsmouth	,, 9	4,225	+ 385	..	..	..	14·5	·75
Preston	,, 13	1,317	+ 208	2	1,317	— 245	..	..
Rotherham	,, 3	1,060	— 25	44	26,087	— 992	12	2
Salford	,, 11	8,740	—1,103	1½	6,673	— 1,000	..	..
Sheffield	,, 12	11,988	+ 748	2⅔	13,880	+ 343	39·62	2·62
Southampton	,, 6	2,643	+ 292	..	..	..	..	..
Southend-on-Sea	,, 13	841	— 332	2	780	— 226	..	..
South Shields	,, 16	991	— 205	2⅔	1,171	— 349	..	..
†Swindon	,, 13	125	— 48	..	..	..	..	..
Tyneside	,, 15	711	— 514	15	5,713	— 295	..	..
Wallasey	,, 16	1,662	— 325	2½	1,936	— 454	..	..
Walthamstow	,, 16	1,237	— 321	2	1,447	— 240	9	..
West Ham	,, 7	5,304	+ 955	..	..	..	15·25	..
Wolverhampton	,, 13	1,667	— 106	2	1,667	— 105	14·25	1·75
Baker St.-Waterloo	,, 16	6,700	+ 650	15	51,435	+ 705	4·25	..
Cen. London Rly.	,, 9	10,462	+ 630	14	77,038	— 665	6·32	·55
Char. +, Eus. Hamp.	,, 16	7,496	— 385	15	57,405	— 140	7·75	..
City & S. Lon. Rly.	,, 17	6,126	+ 402	15	49,506	— 574	7·26	..
Dublin-Lucan Rly.	,, 15	246	+ 47	15	1,704	+ 22	7	..
G.N. and City Rly.	,, 9	2 901	+ 50	14	21,289	— 635	3.5	..
G.N., P'y. & Brmtn.	,, 16	11,830	+1,440	15	90,905	+ 3,750	9·25	..
L'pool Overh'd Rly.	,, 17	2,639	— 111	..	20,734	+ 68	6·8	4·8
Llandudno-Col. Bay	,, 15	314	— 319	19½	2,709	+ 200	..	..
Mersey Railway	,, 16	4,025	+ 20	15	29,948	+ 540	4·5	..
Metropolitan Rly.	,, 10	32,893	+1,594	..	228 874	+ 8,221	24·5	..
Met. District Rly.	,, 16	21.727	+3,447	15	163,117	+16,389	24	..
Anglo Argentine	,, 15	91 034	+9,054	..	650,556	+54.909	..	..
§Auckland	March	14,489	+ 783	12	43.988	+ 2,164	29·3	1·33
Bombay (B.E.T.)	Mar. 18	374	+ 25	11	2,052	+ 132	..	..
§Brisbane	March	17,990	+1,990	..	50,830	+ 5,704	..	..
§Brit. Columbia Rly.	..	..	..	..	..	..	..	..
†Calcutta	April 16	6,955	+ 868	..	..	..	..	..
§Cape Electric T. Ld.	..	..	..	..	..	..	..	..
§Kalgoorlie, W.A.	March	3,633	..	..	10,040	..	20·5	..
Madras	April 15	1,313	— 108	..	9,601	+ 434	..	..
§Lisbon	..	..	..	..	..	..	..	..
†Perth (W.A.)	,, 8	3,238	+ 430	..	22,818	+ 1,572	29	1

* Compared with the corresponding period of 1909. † One week only.
‡ Includes horse, steam and other receipts. § One month.

STOCKS AND SHARES.

Tuesday Evening.

With rubber and oil shares monopolising so large an amount of public attention and public money, other markets have little chance of attracting attention, and the daily record of Stock Exchange activity has come to be very much a case of rubbers and oils first, and the rest nowhere.

Jobbers in the miscellaneous market find so little time for dealing in their usual catalogue of shares that the provincial markets are benefiting considerably by the necessity which forces brokers more and more to seek the country exchanges when their clients want to buy and sell such issues as have a market outside London. The tendency mentioned here last week of people selling other securities in order to pay for rubber and oil ventures is now strongly marked, so that it is customary to ascribe almost any fall in the price of investment descriptions as being due to this cause.

It is popularly stated that a good deal of the large profits made out of rubber shares are in course of diversion into Home Railway stocks. This view is interesting, but in face of the decline in many of the Home Railway prices, its credibility seems a little doubtful. A few speculators managed to put up Home Rails by dint of a small amount of buying about a fortnight ago, but if the movement had been really inspired by public purchases, as suggested, it would hardly have come to an end so rapidly.

City and South London Ordinary has been singled out for special favour, and again the stock exhibits a rise of 1½. The Central London trio is unchanged. Metropolitan Surplus Lands fell 1, but the Consolidated stock kept steady, and Districts are ½ to the good. Underground Electric Railway issues hold their price. Brighton Deferred has gone back, the traffics being less satisfactory, and East Londons are somewhat dull in sympathy with the heaviness apparent in the stocks of the steam railway companies.

The electricity supply market might as well open on two days of the week instead of six, for all the business that it does at the present time. The leading firms of brokers who deal in electric shares are more than fully engaged in rubber business on behalf of their clients, and the movements in prices are brought about by the negotiation of a mere handful of shares. County of London Ordinary and Preference are ⅛ better, and South Londons gained a similar fraction. Oxfords moved up on local demand, and these alterations are the sum total for the week. The Mexican-Canadian division remains quiet, and the changes are insignificant. Mexican Light and Power Common shares are quoted *ex* 1 per cent. dividend, and Rio Trams at 97 are *ex* 1 also.

The feature in the traction market is a further forward movement in British Electric Preference, which are marked up 12s 6d. Explanations for the advance are vague. It is said "there are more buyers than sellers," which is obvious, and that the company has turned the corner of its long lane of depression, and is doing much better. The investor will probably feel more inclined to turn his attention to the Debenture stocks rather than to the shares. London United Tramways Preference are better, too, a 5s. rise taking the price to 3½, and this in spite of the exceedingly bad report just issued. Other tramway and traction issues are quietly firm. British Thomson-Houston 4½ per cent. Debentures rose 1 to 93.

Telegraph stocks and shares present no outstanding features. Anglo-American Telegraph Preferred and Ordinary have been marked *ex* dividend, and so have Direct United States Cable shares, the deduction of 4s. in the case of the latter causing no alteration in the price. The Eastern group is dull. Great Northerns have benefited still further from the good showing made by the report, and Indo-Europeans have maintained their rise. The Trust Companies' stocks and shares are neglected. Mackay Common gained 1, but the Preferred lost its last week's improvement of 2 points. Marconi's shares keep in the neighbourhood of 16s. 3d.

Electric Construction Preference are $\frac{1}{16}$ better. India-rubber shares declined ½, and the rubber market itself has hesitated a good deal. The enormous output of new companies, and the anxiety of shareholders in some of the older ones to secure profits, have re-aroused fears of a possible set-back that will be of a more serious character than those experienced so far in the rubber market. Nevertheless, the newcomers meet, on the whole, with receptions well nigh enthusiastic, and it is the usual thing for the subscription lists of a good concern to be closed very soon after they have opened, so insatiable is the public appetite for rubber shares.

France.—The balance-sheet of the Compagnie Centrale d'Eclairage et de Transport de Force par l'Electricite, of Paris, for the last financial year shows a profit of £21,716, as compared with £20,754 in the preceding 12 months. A dividend of 6 fr. is to be paid on both the preference and ordinary shares.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. *	Dividends for the last four years. 1906.	1907.	1908.	1909.	Closing Quotations April 12th.	Closing Quotations April 19th.	Business done week ended April 19th, 1910. Highest	Lowest.	Rise + or Fall —	Present Yield per cent. £ s. d.
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	Nil	8⅜ — 8⅞	8¾ — 8⅞	..	..	..	Nil.
116,200	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	5 %	5 %	5 %	5 %	100 —102	100 —102	..	..	..	4 18 0
$255,196,600	American Telephone & Telegraph, Cap. Stock ..	$100	8 %	8 %	8 %	8 %	139 —141 xd	140 —142	..	..	+ 1	5 12 8
$58,000,000	Do. Collat. Trust, 4% Bonds, 1 to 28,000 and 58,001 to 78,000	$1000	4 %	4 %	4 %	4 %	93 — 95	93 — 95	93½	..	..	4 4 3
558,460	Anglo-American Telegraph	Stock	3⅞%	3½%	£3 4s.	3⅜%	59 — 61	59 — 61 xd	..	..	..	5 13 10
3,220,770	Do. do. do. 5 % Pref.	Stock	6 %	6 %	6 %	6 %	102¼ —103½	101 —102 xd	103½	101½	..	5 17 8
3,220,770	Do. do. do. Deferred	Stock	1⅜%	1 %	8/-	25/-	18¼ — 18¾	18⅜ — 19½	19	18⅜	..	6 13 4
47,725	Anglo-Portuguese Tel., 5 % Mort. Deb. Stock Red.	100	5 %	5 %	5 %	5 %	99½ —101½	99½ —101½	..	..	..	4 18 6
44,000	Chili Telephone, Nos. 1 to 44,000	5	8 %	8 %	8 %	..	8 1/16 — 8 1/8	8 1/16 — 8 1/8	..	..	..	4 16 3
2,449,176	Commercial Cable, Sing. 500 year 4% Deb. Sk. Red.	Stock	4 %	4 %	4 %	4 %	87 — 89 xd	87 — 89 xd	..	..	..	4 9 11
16,000	Cuba Telegraph	10	5 %	6 %	6 %	6 %	8½ — 9½	8⅜ — 9⅛	..	..	+ ⅛	6 6 4
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	10 %	17 — 18	17½ — 18½	..	..	+ ½	6 9 7
12,981	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	..	3⅛ — 3⅜ xd	3⅛ — 3⅜	..	..	..	5 3 8
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	10 %	7⅞ — 8½ xd	7⅞ — 8½ xd	..	..	..	6 1 3
80,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	100 —102	100 —102	102	101½	..	4 8 8
60,710	Direct United States Cable	20	4⅜%	4½%	4½%	4 %	13½ — 14	13½ — 14 xd	..	..	..	6 1 5
39,500	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200, R.	100	4½%	4½%	4½%	4½%	100 —102	100 —102	..	..	..	4 8 8
4,000,000	Eastern Telegraph, Ord. Stock..	Stock	7 %	7 %	7 %	..	137 —140	136 —139	138½	136	— 1	5 0 9
2,000,000	Do. 8½ % Pref. Stock..	100	8½%	8½%	8½%	8½%	86 — 88	86 — 88	87½	87½	..	4 1 5
1,896,708	Do. 4 % Mort. Deb. Stock. Red. ..	Stock	4 %	4 %	4 %	4 %	103 —105	103 — 105	..	..	..	3 10 2
900,000	Eastern Extension, Australasia, and China Tele	10	7 %	7 %	7 %	..	12⅝ — 13⅛	12⅝ — 13⅛	12⅛	12⅝	— ⅛	5 6 8
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	101 —103	101 —103	..	..	..	3 17 8
200,000‡	East. & S. Afric. Tel., 4 % Mt Db. Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	101 —103	100 —103	..	..	..	3 17 8
181,127	Globe Telegraph and Trust	10	5⅛%	5⅛%	5⅛%	..	10½ — 11	10½ — 11	10⅞	10½	..	5 4 7
181,127	Do. do. 6 % Pref...	10	6 %	6 %	6 %	6 %	13⅜ — 13⅝	13⅜ — 13⅝	..	..	..	4 8 1
150,000	Great Northern Telegraph, of Copenhagen.. ..	10	20 %	20 %	18 %	..	3.. — 32	31½ — 32½	..	..	+ ½	5 11 8
5,000	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,300, Red.	100	4½%	4½%	4½%	4½%	100 —102	100 —102	..	..	..	4 8 3
17,000	Indo-European Telegraph	25	18 %	18 %	18 %	18 %	54½ — 56½	54½ — 56½	..	..	..	5 14 0
$41,880,400	Mackay Companies Common	$100	3½%	4 %	4 %	4½%	91 — 93	91 — 93	..	..	..	4 11 5
$50,000,000	Do. do. 4% Cum. Pref.	$100	4 %	4 %	4 %	4 %	80 — 84	78 — 80	..	..	..	4 15 8
894,190	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	..	3/16 — ¼	3/16 — ¼	17/6	15/6	..	Nil
72,680	Monte Video Telephone Co., Ltd. Ord.	1	6 %	6 %	6 %	6 %	⅞ — 1	⅞ — 1	..	..	..	6 0 0
88,492	Do. do. do. 5 % Pref.	1	5 %	5 %	5 %	5 %	3/16 — ¼	3/16 — ¼	..	..	..	5 6 8
2,225,000	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	104 —105½	104 —105½	104½	103½	..	5 13 9
3,725,000	Do. do. Def. Stock	100	5 %	6 %	6 %	6 %	123½—125½	124 —126	125½	123½	+ ½	4 15 3
15,000	Do. do. 6 % Cum. 1st. Pref.	10	6 %	6 %	6 %	6 %	10⅜ — 10⅝	10⅜ — 10⅝	..	..	..	5 10 4
15,000	Do. do. 6 % Cum. 2nd Pref.	10	5 %	6 %	6 %	6 %	10 — 10⅜	10 — 10⅜	..	..	..	5 11 8
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5⅜ — 5⅝	5⅜ — 5⅝	..	..	..	4 8 11
2,000,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	3½%	98 —100	97½ — 99½	98	97½	— ½	3 12 2
1,988,593	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	100 —102	99 —101	99	98½	— 1	3 19 3
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid ..	1	7 %	8 %	8 %	8 %	1 1/16 — 1 1/8	1 1/16 — 1 1/8	28/9	26/10½	..	5 6 8
50,000	Do. do. do. 6 % Cum. Pref... ..	1	6 %	6 %	6 %	6 %	1 1/16 — 1 1/8	1 1/16 — 1 1/8	..	..	..	4 14 9
195,955	Do. do. do. 4 % Red. Deb. Stock	100	4 %	4 %	4 %	4 %	86 — 88	86 — 88	..	..	..	4 10 11
99,400	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	10	4 %	4 %	4 %	4 %	98 —100	98 —100	..	..	..	4 0 0
11,889	Reuter's	8	5 %	5 %	5 %	..	7⅞ — 8⅛	7⅞ — 8⅛	..	..	..	4 18 9
145,955	Telephone Co. of Egypt, 4½ % Deb. Red.	100	4½%	4½%	4½%	4½%	100 —102	100 —102	100¼	..	..	4 8 8
3,042	Submarine Cables Trust	Certs.	6 %	6 %	6 %	..	131 —134	128 —131 xd	..	..	..	4 11 7
120,000	United River Plate Telephone	5	8 %	8 %	8 %	..	7⅛ — 7⅜	7⅛ — 7⅜	7⅛	6⅞	..	5 8 6
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	5⅜ — 5⅝	5⅜ — 5⅝	..	..	..	4 8 11
80,008	W. Coast of America, 1 to 80,000 & 58,001 to 58,008	2½	2½%	2½%	2½%	..	1⅜ — 1⅝	1⅜ — 1⅝	..	..	..	3 16 4
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Bras. Sub. Tel.	100	4 %	4 %	4 %	4 %	98 —100	98 —100	..	..	..	4 0 0
207,980	Western Telegraph, Ltd., Nos. 1 to 207,980.. ..	10	7 %	7 %	7 %	..	13⅜ — 14⅛	13⅜ — 14⅛	13⅜	..	..	4 18 8
800,000	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	101 —103	101 —103	..	..	..	3 17 8
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	..	1/16 — 1/8	1/16 — 1/8	..	..	..	Nil
84,568	Do. do. 6 % Cum. 1st Pref.	10	8 %	6 %	6 %	..	8½ — 9½	8½ — 9½	8⅛	..	..	6 9 9
4,869	Do. do. 6 % Cum. 2nd Pref.	10	Nil	£2 6	15 %	..	8½ — 9½	8½ — 9½	..	..	..	6 9 9
80,000‡	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	5 %	100½—102½	100½—102½	102	..	..	4 17 1

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

640,000	Anglo-Argentine Trams, 5 % Cum. 1s Pref., 1 to 640,000	5	..	..	..	5 %	4 7/16 — 4 1/2	4 7/16 — 4 1/2	95/-	93/1½	..	5 1 8
500,000	Do. 5 % 2nd Pref., 800, to 1,300,000	5	..	..	..	5 %	4 7/16 — 4 1/8	4 7/16 — 4 1/8	91/3	..	..	5 6 8
4,465,674	Do. 4 % Deb. Stock	Stock	..	..	..	4 %	90 — 91½	90⅜ — 92	91⅜	91	+ ⅜	4 7 0
882,387	Auckland E. Trams, 5 % 1st Mort. Deb. Stock ..	100	5 %	5 %	5 %	5 %	105 —107	105 —107	105	..	..	4 13 6
880,000	Babcock & Wilcox, 1 to 880,000..	1	20 %	20 %	20 %	24 %	5⅛ — 5⅜	5⅛ — 5⅜	5 5/16	5 3/16	..	4 16 3
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	6 %	6 %	6 %	6 %	1 1/16 — 1 1/16	1 1/16 — 1 1/16	..	..	..	4 9 5
60,000	British Aluminium, Ord., 1 to 40,000	5	7 %	7 %	Nil	..	..	..	..	..	..	8 19 2
60,000	Do. do. 7 % Cum. Pref.	5	7 %	7 %	3½%	..	..	..	..	..	..	Nil
40,100	Do. do. "A" 6 % Cum. Pref.	5	6 %	6 %	6 %	..	..	..	..	..	..	..
12,897	Do. do. 4 % Funding Certs.	5	4 %	4 %	2 %	..	..	..	..	..	..	..
124,400	Do. do. 5½ % Loch Leven Debs. ..	100	5½%	5½%	5½%	5½%	95 — 98	97 —100	..	..	+2	5 10 0
500,000	British Columbia E. Rail Def. Ord. Stock	100	6 %	8 %	8 %	8 %	144 —148	145 —150	148	..	+1½	5 6 8
400,000	Do. Pref. Ord. Stock	100	5 %	5 %	6 %	6 %	121 —125	121 —125	123	121	..	4 11 7
400,000	Do. 5 % Cum. Perp. Pref. Stock	100	5 %	5 %	5 %	5 %	190½—111½	110 —112	111½	110½	+ ½	4 16 0
288,000	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	4½%	4½%	4½%	4½%	102 —104	101 —103	..	..	—1	4 9 3
212,600	Do. 4½ % Vancouver Power Debs., 1 to 2,800	100	4½%	4½%	4½%	4½%	102 —105	102 —105	104½	104½	..	4 7 5
188,801	British Electric Traction	10	Nil	Nil	Nil	..	1 — 1½	1 — 1½	25/-	..	..	4 5 9
161,487	Do. do. 6 % Cum. Pref.	10	6 %	3 %	1½%	..	3½ — 3⅝	3⅝ — 4⅛	8s/9	7s/9	+ ⅛	Nil
1,478,658	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	..	90 — 93 xd	90 — 93	..	..	..	3 8 7
528,986	Do. do. 4½ % 2nd Deb. Stock Red.	100	4½%	4½%	4½%	..	68 — 72	68 — 72	..	..	..	5 7 6
100,000	British Insulated and Helsby Cables	5	10 %	10 %	10 %	10 %	6⅞ — 7⅛ xd	6⅞ — 7⅛	..	..	..	6 6 0
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	6 — 6⅜	6 — 6⅜	..	..	..	6 17 11
500,000	Do. do. 4½ % 1st Mort. Deb. Red. ..	100	4½%	4½%	4½%	4½%	103 —106	103 —106	..	..	..	4 12 4
304,940‡	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	4½%	4½%	4½%	4½%	90 — 94	91 — 95	..	..	+1	4 12 4
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 75,000	5	Nil	Nil	Nil	..	⅜ — 5/16	⅜ — 5/16	8/-	..	..	4 14 9
1,916,353	Do. do. 4 % Mort. Deb. Stock ..	100	4 %	4 %	4 %	..	47 — 51	47 — 51	47	..	..	Nil
50,000	‡Browett, Lindley & Co., Ord.	1	Nil	Nil	Nil	..	7/16 — 11/16	7/16 — 11/16	..	..	..	7 16 10
50,000	‡ Do. do. 6 % Cum. Pref.	1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..	Nil
140,976	Brush Electrical Engineering, Ord., 1 to 105,731 ..	2	Nil	Nil	Nil	..	0 — ⅛	0 — ⅛	..	..	..	Nil
200,000	Do. do. Non-cum. 6 % Pref.	2	Nil	Nil	Nil	..	0 — ⅛	0 — ⅛	..	..	..	Nil
135,000‡	Do. do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	39 — 44	39 — 44	..	..	..	Nil
195,000‡	Do. do. 4½ % Perp. 2nd Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	25 — 29	25 — 29	..	..	..	10 4 6
187,610	Calcutta Trams, 1 to 187,610	5	8 %	6 %	4½%	4½%	4⅜ — 4⅞	4⅜ — 4⅞	..	..	..	15 3 0
45,804	Do. 5 % Cum. Pref., Nos. 1 to 29,880..	5	5 %	5 %	5 %	5 %	4½ — 5	4½ — 5	..	..	..	4 12 4
950,000	Do. 4½ % 1st Deb. Stock..	100	4½%	4½%	4½%	4½%	99 —102	99 —102	..	..	..	5 0 0
85,000	Callender's Cable Construction shares	5	15 %	15 %	15 %	..	10 — 10⅜	10 — 10⅜	10⅜	..	..	4 8 8
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..	6 19 6
800,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	102½—104½	102½—104½	..	..	..	4 10 11
491,223	Cape E. Trams., 1 to 491,223	1	Nil	Nil	Nil	..	2/16 — 3/16	2/16 — 3/16	..	..	..	4 6 2
450,000	Castner-Kellner Alkali, 1 to 450,000	1	8 %	12 %	12½%	..	2⅞ — 2⅛	2⅛ — 2⅜	55/6	53/3	+ ⅛	Nil
210,158	Do. do. 4½ % 1st Mort. Deb. Stock	100	4½%	4½%	4 %	4½%	104 —107	104 —107	..	..	..	4 9 3
1,890 690	Central London Railway, Ord. Stock..	Stock	4 %	3 %	3½%	3 %	70 — 72	70 — 72	..	..	..	4 4 1
554,655	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	4 %	86 — 88	86 — 88	86½	..	..	4 9 4
554,655	Do. do. Def. do.	Stock	4 %	2 %	2½%	2 %	53 — 55	53 — 55	53½	..	..	4 10 11
1,480,000	City and South London Railway	Stock	2½%	3½%	1½%	1½%	34½ — 35½	36 — 37	36⅞	35	+1½	3 12 9
85,000	Crompton & Co., Nos. 1 to 85,000	8	5 %	5 %	Nil	..	⅜ — ⅝	⅜ — ⅝	..	..	..	4 14 7
100,000‡	Do. 5 % 1st Mort. Reg. Debs., 1 900 of £100, and 901 11,000 of £50 Red	..	5 %	5 %	5 %	5 %	88 — 91	88 — 91	..	..	..	Nil
												5 9 11

* Unless otherwise stated, all shares are fully paid. ‡ From Manchester Share List.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—(*Continued*)

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years. 1906.	1907.	1908.	1909	Closing Quotations April 12th.	Closing Quotations April 19th.	Business done week ended April 19th, 1910. Highest	Lowest.	Rise + or Fall —	Present Yield per cent. £ s. d.
250,000	Dick, Kerr & Co., 1 to 250,000	1	10 %	10 %	6 %	.	⅞ — 1	⅞ — 1	..	..	..	6 0 0
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000 ..	1	6 %	6 %	6 %	6 %	1 3/32 — 1 5/32 xd	1 3/32 — 1 5/32	21/8	..	..	5 4 4
271,080	Do. do. 4½ % Deb. Stock	100	4½ %	4½ %	4½ %	4½ %	99 —102	99 —102	..	..	..	4 8 3
60,000	Dublin United Trams. (1898), 6 % Pref., 1 to 60,000	10	6 %	6 %	6 %	6 %	13 — 14	13 — 14	..	..	..	4 7 8
99,261	Edison & Swan Utd., "A" shs., £3 pd., 1 to 99,261	5	4½ %	2½ %	Nil	..	1/16 — 3/16	1/16 — 3/16	..	..	..	Nil
17,189	Do. do. "A" shares, 01—017,189 ..	5	4½ %	2½ %	Nil	..	¼ — 1½	⅛ — 1½	..	..	..	Nil
307,895	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	65 — 70	65 — 70	..	..	..	5 14 4
67,720	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	79 — 82 xd	79 — 82	..	..	..	6 1 11
112,100	Electric Construction, 1 to 112,100	1	Nil	Nil	Nil	..	½ — ⅝	½ — ⅝	..	..	..	Nil
81,890	Do. do. 7 % Cum. Pref., 1 to 81,890..	1	7 %	7 %	7 %	7 %	1¼ — 1⅜	1 5/16 — 1 7/16	..	..	+ 3/16	9 0 8
25,000	General Electric Co. (1900), 5 % Cum. Pref. ..	10	5 %	5 %	5 %	..	7⅞ — 8⅛	7⅞ — 8⅛	..	..	..	6 1 3
200,000	Do. do. 4 % Mort Deb.. ..	Stock	4 %	4 %	4 %	4 %	82 — 86	82 — 86 xd	..	..	..	4 13 0
75,000	Gt. N. & City Rail. Pref. Ord. "A" 4 %, 1 to 75,000	10	4 %	½ %	Nil	..	⅝ — ¾	⅝ — ¾	..	..	..	Nil
96,000	Greenwood & Batley, 7 % Cum. Pref.	10	7 %	7 %	..	..	10½ — 10¾	10½ — 10¾	..	..	..	6 10 8
80,000	Do. do. 5 % Mort. Debs.	100	5 %	5 %	5 %	..	102 — 103⅛	102 —103½	..	..	+ 1/16	4 16 10
40,000	Henley's (W. T.), Telegraph Works, Ord.	5	15 %	15%	15 %	15 %	12⅜ — 13¼	12⅜ — 13¼	..	..	..	5 14 3
40,000	Do. do. 4½ % Pref.	5	4½ %	4½ %	4½ %	4½ %	5 — 5⅛ xd	5 — 5⅛	5 5/16	..	..	4 3 9
150,000	Do. do. 4½ % Mort. Deb. Stock	Stock	4½ %	4½ %	4½ %	4½ %	105½—107½	105½—107½	..	..	..	4 3 9
50,000	India-Rubber, Gutta-percha & Telegraph Works..	10	10 %	10 %	10 %	10 %	15½ — 16½	15½ — 16	15⅝	15½	— ½	6 5 0
57,500	†Liverpool Overhead Railway, Ord.	10	Nil	½ %	Nil	Nil	7/16 — 9/16	7/16 — 9/16	..	..	..	Nil
10,000	† Do. do. Pref., fully paid ..	10	5 %	5 %	5 %	5 %	5 — 5½	5 — 5½	..	..	+ ½	8 13 11
600,070	London United Trams. (1901), 1 to 50,007	10	8 %	8 %	Nil	..	1½ — 2⅛	1⅝ — 2⅛	..	..	..	Nil
599,980	Do. do. 50,008 to 100,000	10	8 %	8 %	Nil	..	1½ — 2⅛	1⅝ — 2⅛	..	..	..	Nil
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	5 %	5 %	3 2/3 %	..	2⅞ — 3⅛	3 — 3⅛	67/6	66/8	+ ½	10 14 4
1,649,980	Do. do. 4 % 1st Mort. Deb. Stock ..	100	4 %	..	4 %	4 %	71 — 74	71 — 74	..	..	..	5 8 1
5,782,062	Metropolitan Consolidated	100	1 %	⅓ %	⅔ %	1 %	44½ — 45	44½ — 44⅞	45⅛	44½	— ¼	2 4 8
2,640,914	Do. Surplus Lands	100	22½%	22½%	22½%	22½%	68 — 70	67 — 69	68⅛	68	—1	3 19 9
3,235,000	Do. District	100	Nil	Nil	Nil	Nil	22⅜ — 23½	23 — 23⅝	23⅛	22⅝	+ ¼	Nil
891,887	Metropolitan Electric Trams., Ord.	1	..	..	4½%	..	31/32 — 33/32	31/32 — 33/32 xd	15/-	..	..	5 15 0
314,016	Do. do. Defd...	1	Nil	Nil	Nil	..	15/16 — 1	15/16 — 1	1 1/16	..	..	Nil
600,000	Do. do. 5 % Cum. Pref. ..	1	5 %	5 %	5 %	5 %	1 1/16 — 1 1/8	1 1/16 — 1 1/8	..	..	..	6 8 1
595,600	Do. do. 4½ % Deb. Stock Red.	100	4½%	4½%	4½%	4½%	96 — 99	97 —100	99	97½	+1	4 10 0
£10,823,200	Mexico Trams Co., Common Stock	..	..	..	..	..	183 —184	130½ —182½ xd	..	..	..	..
$9,000,000	Do. 1st Mort. 50-year 5% Gld. Bds.	..	..	..	5 %	..	94½ — 95½	95 — 96	95⅞	95½	+ ⅛	5 4 2
245,500	Potteries Electric Traction	1	4 %	4 %	Nil	..	3/16 — 5/16	3/16 — 5/16	..	..	..	..
245,500	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	3/16 — 5/16	3/16 — 5/16	..	..	..	6 17 11
245,000	Do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	84 — 87	84 — 87	..	..	..	5 3 6
37,850	Telegraph Construction and Maintenance	12	15 %	17½%	15 %	17½%	34 — 35½ xd	34 — 35½	34	..	..	5 16 0
140,000	Do. 4 % Deb. Bds., 1 to 1,500 Red., 1909	100	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..	3 18 5
1,000,000	Underground Electric Railway, 5% Prior Lien ..	..	..	..	5 %	..	102½—103½	102½—103½	103½	..	..	4 16 7
2,800,000	Do. do. 4% Bonds	..	..	..	4½%	4½%	89 — 91	89 — 91	90⅝	90½	..	4 18 4
4,900,000	Do. do. 6% Income Bonds ..	..	..	..	..	..	38 — 40	38 — 40	39½	38⅜	..	..
66,666	Willans & Robinson, 1 to 80,000 & 80,001 to 116,666	1	Nil	10 %	5 %	Nil	½ — ⅝	½ — ⅝	..	..	..	..
66,666	Do. 5 % C.P., 80,001 to 80,000 & 125,001 to 141,666	5	..	6 %	6 %	3 %	1½ — 2½	1½ — 2½	37/6	..	..	1 4 2
245,495	Do. % 1st Mort. Deb. Stock		4 %	4 %	4 %	4 %	68 — 78	68 — 78	..	..	..	5 9 7

ELECTRICITY SUPPLY COMPANIES.

15,000	Bromley (Kent) E.L. & P., 1 to 15,000	5	5½%	5½%	5½%	5½%	4¼ — 4⅜	4¼ — 4⅜	..	..	..	5 15 9
70,000	Do. do. 4½ % 1st. deb. stock ..	100	4½%	4½%	4½%	4½%	91 — 94	91 — 94	..	..	..	4 18 9
80,442	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	10%	10 %	10 %	10 %	7⅜ — 7⅞	7⅜ — 7⅞	7 9/16	7⅜	..	6 10 1
9,551	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	7 — 7⅛	7 — 7⅛	..	..	..	4 13 4
400,000	Central Electric Supply 4 % Guar. Deb. Stock ..	100	4 %	4 %	4 %	4 %	100 —103	100 —103	..	..	..	3 17 8
80,000	Charing Cross and Strand Electricity Supply ..	5	5 %	5 %	5 %	5 %	4 — 4¼ xd	4 — 4¼	83/9	..	..	5 11 1
80,000	Do. do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	4½%	4¼ — 4⅜	4⅛ — 4⅜	..	..	..	4 17 4
80,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	4½%	3⅞ — 4⅛	3⅞ — 4⅛	..	..	..	5 2 10
445,736	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	97 —100	97 —100	..	..	..	4 0 0
49,496	Chelsea Electricity Supply, Ord.	5	4½%	4½%	4½%	4½%	8⅞ — 4¼ xd	8⅞ — 4¼	..	..	— ⅛	5 9 1
175,000	Do. do. 4½ % Deb. Stock Red. ..	Stock	4½%	4½%	4½%	4½%	101 —103	101 —103	101½	..	..	4 7 5
70,598	City of London Elec. Lighting, Ord. 40,001—110,598	10	6 %	6 %	6 %	7 %	11⅛ — 12 xd	11⅛ — 12	..	..	..	5 16 8
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	12 — 13 xd	12 — 13	11 29/32	11⅞	..	4 12 4
400,000	Do. 5 % Db. Stk.	Stock	5 %	5 %	5 %	5 %	121 —125	121 —125	..	..	..	4 0 0
800,000	Do. 4½ % 2nd. Db. Stk.	100	4½%	4½%	4½%	4½%	99 —102	99 —102	..	..	..	4 8 3
50,000	County of Durham Electrical Power, Ord.	5	4 %	2 %	Nil	Nil	1½ — 2	1½ — 2	..	..	..	5 0 0
50,000	Do. do. do. 5 % Pref. ..	5	5 %	5 %	5 %	5 %	2¾ — 3⅛ xd	2¾ — 3⅛	..	..	..	7 13 10
250,000	Do. do. do. 5 % 1st Mtg. Deb.	Stock	..	..	5 %	5 %	94 — 96	94 — 96	..	..	..	5 4 2
40,000	County of London Electric Lighting, Ord. 1—40,000	10	5 %	5 %	5 %	5 %	7⅝ — 8⅛	7⅞ — 8⅛	8 3/16	7 13/16	+ ⅛	6 1 3
55,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	10⅝ — 11⅛ xd	10⅝ — 11⅛	11⅛	10⅝	+ ⅛	5 6 8
400,000	Do. do. 4½ % Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	103 —106	103 —106	102½	..	..	4 4 11
400,000	Do. do. 4½ % 2nd. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	100 —103	100 —103	..	..	..	4 7 5
80,000	Edmundson's Electric Corporation, Ord. Shares ..	5	Nil	Nil	Nil	..	1/16 — 3/16	1/16 — 3/16	..	..	..	Nil
80,000	Do. do. 6 % Cum. Pref.	5	8 %	Nil	Nil	..	1¼ — 1½	1¼ — 1½	31/3	..	..	Nil
430,500	Do. do. 4½ % 1st Mort. Deb. Stk.	100	4½%	4½%	4½%	..	72 — 75	72 — 75	..	..	..	6 0 0
$8,150,000	Electrical Dev.Co.of Ontario, 5% 1stMtg.Gold Bnds.	$500	..	..	5 %	5 %	83 — 86	83 — 86	84	..	..	5 16 3
10,000	Folkestone, 1 to 10,000	5	5½%	5½%	5½%	5½%	4¼ — 4⅜ xd	4¼ — 4⅜ xd	..	..	..	5 15 9
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	5 %	5 %	5 %	5 %	4⅝ — 5⅛ xd	4⅝ — 5⅛ xd	..	..	..	4 15 8
90,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	93 — 96	93 — 96	..	..	..	4 13 9
15,000	Hove, 1 to 15,000	5	9 %	8½%	8½%	8½%	7 — 7½ xd	7 — 7½ xd	..	..	..	5 13 4
$1,976,000	Kaministiquia Power Co., 5 % Gold Bnds.	100	..	..	5 %	5 %	102½—104½	102½—104½	..	..	..	4 15 8
21,000	Kensington and Knightsbridge Electric Ord. ..	5	10 %	10 %	8 %	8 %	7 — 7⅛	7 — 7⅛	..	..	..	5 6 8
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	94⅛ — 96½	94⅛ — 96½	..	..	..	4 2 11
111,000	London Electric Supply Corporation, Limited, Ord.	3	4 %	2½%	3 %	..	1⅝ — 2	1⅝ — 2	32/6	..	..	4 8 11
70,000	Do. do. do 6 % Pref. ..	5	6 %	6 %	6 %	..	4⅜ — 5¼	4⅜ — 5¼	..	..	..	5 14 3
882,855	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4½%	4½%	4 %	4 %	92 — 94	92 — 94	..	..	..	4 5 1
200,000	Metropolitan Electric Supply, 1 to 100,000	5	8 %	6½%	5 %	5 %	4 — 4¼	4 — 4¼	88/8	..	..	5 11 1
75,121	Do. 4½ % Cum. Pref. 1—71,106 ..	5	4½%	4½%	4½%	4½%	4⅝ — 5	4⅝ — 5	..	..	..	4 10 0
235,000	Do. 4½ % 1st Mort. Deben. Stock ..	Stock	4½%	4½%	4½%	4½%	104 —107	104 —107	..	..	..	4 4 1
248,000	Do. 3½ % Mort. Deben. Stock Redem.	Stock	3½%	3½%	3½%	3½%	83 — 86	83 — 86	..	..	..	4 1 6
$6,000,000	Mexican Electric Light Co., 5% 1st Mtg. Gold Bnds	100	5 %	5 %	5 %	..	84½ — 85½	84½ — 85½	84¾	84½	..	5 16 3
18,585,000	Do. Light and Power Co., Ltd., Common ..	$100	..	..	3½%	..	81 — 83	80 — 82 xd	81	80½	..	4 5 4
$2,400,000	Do. do. 7% Cum. Pref. Stk.	Stock	..	..	7 %	7 %	103½—105½	103½—105½	104⅝	104½	..	6 12 8
12,000,000	Do. do. 5% 1st Mtg. Gold Bnds.	100	..	..	5 %	5 %	90 — 91	89½ — 90¼	90½	89½	— ½	5 10 2
950,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	96½ — 98¾	96½ — 98½	..	..	..	4 11 5
180,491	Newcastle-on-Tyne, 1 to 187,500	5	8 %	8 %	2½%	..	4¼ — 4⅜ xd	4¼ — 4⅜	..	..	..	2 15 0
187,500	Do. 5 % Pref., 1 to 187,500	5	5 %	5 %	5 %	5 %	4¼ — 4½	4⅜ — 4½	..	..	+ ⅛	5 2 7
126,500	North Metropolitan Electric Power Supply Co., 5 % Mortgages (Red.), Nos. 1 to 1,265	100	..	..	..	5 %	99 —101	97 — 99 xd	..	..	..	5 1 0
10,852	Notting Hill Electric Lighting	10	7½%	7½%	7 %	..	11⅞ — 12⅜ xd	11⅞ — 12⅜	..	..	..	5 9 10
20,000	Oxford, 1 to 96 and 407 to 20,819	5	7 %	7 %	7 %	7 %	6¼ — 6⅜ xd	6⅜ — 7	..	..	+ ⅛	5 0 0
60,000	Do. 4 % Deb. Stock	100	4 %	4 %	4 %	4 %	94 — 97	94 — 97	..	..	..	4 2 6
119,694	River Plate Elcty. Co. Ord. Nos. 1 to 120,507 ..	1	2½%	2 %	2 %	..	1⅞ — 2	1⅞ — 2	..	..	..	4 0 0
100,000	Do. do. 6% Non Cum. Pref. Nos. 1 to 100,000	1	6 %	6 %	6 %	6 %	1 29/32 — 1 31/32	1 29/32 — 1 31/32	..	..	..	4 16 0
200,000	Do. do. 5% Deb. Stk. Red.	100	5 %	5 %	5 %	5 %	103 —105	103 —105	..	..	..	4 15 3
40,000	St. James' and Pall Mall Electric Light, Ord. ..	5	10 %	10 %	10 %	10 %	8¾ — 9	8¾ — 9	..	..	..	5 14 8
80,000	Do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	7 %	6⅞ — 7¼	6⅞ — 7¼	..	..	..	5 7 8
150,000	Do. do. 3½ % Deb. Stock Red. ..	100	3½%	3½%	3½%	3½%	84 — 88	84 — 88	..	..	..	3 19 7
12,000	Smithfield Markets Electric Supply, Ord.	5	Nil	Nil	Nil	..	1⅜ — 2⅛	1⅜ — 2⅛	..	..	..	Nil
65,000	South London Electric Supply, Ord.	4	3 %	4 %	5 %	5 %	2⅜ — 3 xd	2⅜ — 3⅛	..	..	+ ⅛	6 9 0
130,100	Do. do. 5 % 1st Mort. Deb.	100	..	..	5 %	5 %	100 —103	100 —103	..	..	..	..
120,000	South Met. Elec. Lt. & Power, Ord.	1	2½%	2½%	2½%	..	15/16 — 1	15/16 — 1	..	..	..	4 8 11
142,968	Do. do. 7 % Pref.	1	7 %	7 %	7 %	7 %	1 — 1⅛	1 — 1⅛	..	..	..	6 4 5
294,520	Do. do. 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	98 —101 xd	98 —101	..	..	..	4 9 1
80,000	Urban Electric Supply, Ord.	5	5 %	..	5 %	..	⅞ — 1 xd	⅞ — 1	..	..	..	10 0 0
60,000	Do. do. 5 % Cum. Pref.	5	5 %	..	5 %	..	1⅝ — 2 xd	1⅝ — 2	..	..	..	10 10 6
275,000	Do. do. 4½ % 1st Mort. Db. Stk. Red.	100	4½%	4½%	4½%	4½%	79 — 81 xd	79 — 81	79	..	..	5 11 1
808,000	Victoria Falls Power Co., Pref. Nos. 1 to 808,000 ..	1	..	..	5 %	..	⅜ — ⅝	⅜ — ⅝	..	..	..	5 6 8
100,00	Westminster Electric Supply, Ord.	5	12 %	10 %	10 %	10 %	8¾ — 9	8¾ — 9	9	8 13/16	..	5 11 1
51,279	Do. do. 4½ % Cum. Pref. Reduced from 5% since 31st Dec., 1905)	5	4½%	4½%	4½%	4½%	5 — 5⅛	5 — 5⅛	..	..	..	4 1 10

* Unless otherwise stated, all shares are fully paid. † Quotations on Liverpool Stock Exchange.

Bank rate of Discount 4 per cent. March 17th. 1910.

PROCEEDINGS OF INSTITUTIONS.

Some Notes on Standardisation of Electrical Machines.

By R. Orsettich, M.I.E.E.

(*Abstract of paper read before the* Institution of Electrical Engineers, *Birmingham, March 9th, and Glasgow, March 15th*, 1910.)

The author proposes to discuss mainly in this paper some of the arrangements generally adopted for production, under the headings of "Standardisation" and "Production in Quantities."

The standardisation consists in selecting for manufacture a definite number of types and sizes as answering average requirements, and in designing them in such a way that they are eminently suited for production in large quantities. All details of these types must be fixed so as to make it possible by partial modifications to fill requirements of special conditions with the minimum of alterations to patterns and stock, and, therefore, with the minimum of expense.

The production in quantities has the object of reducing the cost connected with putting the machine through the shop by distributing this cost, which is to a certain extent independent of the quantity, over a large number of machines. The manufacture of large quantities of the same type also enables the shop to acquire the materials in larger lots, and, therefore, in the most suitable market, with consequent reduction in cost. It further enables the shop to adopt all modern methods of checking interchangeability of parts by the use of limit gauges and jigs, which would be too expensive if only a few machines were made. The benefit of keeping one's workmen constantly employed on the same line of work shows itself in the increased skill they acquire in the performance of the operations or in the handling of a given machine. The time required for the work is in this way reduced to the minimum, as well as the time lost between operations, and the efficiency of the machine tools becomes higher, whilst the man at the same time obtains part of the gain in some form of bonus for his extra exertion.

The requirements of the market being of a fluctuating nature, it is impossible to fill the demand otherwise than by estimating the average requirements over a period corresponding to the time necessary for the manufacture of the goods. From the above it follows that the conditions for carrying out successfully the production of machines on a large scale should be:—

1. The manufacture for stock only and not for individual orders.
2. To have as few types as possible, and to use as many parts as possible in common amongst the different types.
3. To concentrate the aim of the design on the production of perfectly interchangeable and mechanical details, even if the cost of machining is somewhat high, with a view to reducing the cost of assembling the different parts, which can only be done individually.
4. Regularity of the demand of the market.
5. Even and continuous supply of raw materials and labour.

The requirements of the selling side of the business are almost in direct opposition to the requirements of the shop. A compromise has, therefore, to be arrived at.

The salesman requires the number of types which he can offer to be kept as high as possible, so as not to be underbid by another salesman offering a type which comes nearer to the requirements of the client. The Standards Committee reduced the number of sizes below what had been accepted as normal practice by a number of firms, and most firms still manufacture many more sizes than are mentioned in the Committee's report. My experience is that for a line of standard continuous-current machines between 1 H.P. at 2,000 R.P.M. and 100 H.P. at 1,000 R.P.M. there are usually employed from 18 to 20 types, and practically the same number for a line of three-phase motors between 1 H.P. at 1,500 R.P.M. and 100 H.P. at 750 R.P.M. These numbers are based on an approximate output of some 500 machines per year of the smaller size up to about 25 machines per annum of the larger size. For the splitting-up of machines of larger outputs into types, technical considerations are more decisive.

A few standard types should be always available for immediate delivery. This does not offer any difficulty in connection with continuous-current machines, but with alternating current the matter is very difficult, as one has single-phase, two-phase and three-phase supplies, the voltages of which vary considerably as well as the frequency. For single-phase the matter of fixing a stock is almost impossible, owing to the frequencies ranging between 25 and 133.

Machines have to be made with ample margin in all directions, viz., mechanical strength, heating, sparking, wear, &c. Shunt regulation in continuous-current motors, together with overloading capacity, is one of the points which offer most difficulties.

Special Machines cannot be entirely avoided, as it is impossible to make standard machines cover the entire range of applications. It is a most complicated question to inquire into the extra price that should be charged for the making of an entirely special machine, and it will be impossible to persuade any one not connected with actual manufacturing that such jobs are hardly desirable from the turnover and profit point of view. Even if a firm does not wish to undertake this kind of work, it will sometimes be unavoidable if special machines are required in connection with large contracts for standard work.

Successful manufacture is necessarily based on the smooth operation of the department concerned with the supply of raw materials.

The materials to be kept in stock have to be fixed by the engineers with reference to the nature and extent of the manufacture, and a schedule of standards has to be drawn up stating the number and quality of the different materials; of each kind a definite number of varieties only is accepted, and no deviation is allowed from these unless special permission is obtained from the management.

At the same time, specifications have to be prepared giving full particulars of the materials, the tests with which they have to comply, and the limits for their acceptance. The inspection of incoming materials in large works requires a wide experience and scientific training, as the inspector has very often to exercise his own discretion as to the advisability of accepting certain material, which might not be to the letter of the specification without being faulty, and the rejection of which might seriously handicap the shop output.

The stores must work on a basis of automatic replacement by fixing maximum and minimum limits of stock. These two limits must vary according to the conditions of the sales of the finished machines. It is, therefore, important that the limits should be revised periodically.

In addition to raw materials, a large quantity of the stock consists of half or fully-finished parts, and this kind of stock can be kept in three different ways:—

1. Only parts which are common to several types are built for stock.
2. Parts belonging to individual types also are manufactured in advance and kept in stock.
3. All parts without exception belonging to any of the machines manufactured are kept in stock, so that all machines are assembled complete from the components. This is only possible when there is a large demand for entirely standard and identical machines.

The usual condition for an average factory would be corresponding to stage No. 2, because this combines the advantages of a fairly flexible system with minimum expenditure.

One of the points of great importance in dealing with standard or semi-standard machines is that whenever an alteration is required in a standard design for any reason, the machine has always to be assembled from components, and the alteration must not be done under any conditions on a finished machine.

Another question of importance in the handling of stock parts is to be found in the method of allocating the stock to the different orders. This can be done by entering on the stock card a requisition for the number of parts to be used for a certain order, and regarding these parts as being appropriated for this order whilst they are remaining on their shelves; in this system the "minimum" quantity might be reached on the card at any time, whilst a larger number of parts still existed in the stores. Another system consists in removing the parts as soon as requisitioned for an order to a different part of the shop, where all items belonging to a certain order are collected. This method is the safer, as it makes absolutely certain of the parts being in existence and not only on paper.

Mechanical Considerations.

Diameter of Bore.—This will be fixed as a starting-point of the whole line of machines, and will be based on the most suitable dimensions to obtain a given output. The length of the core will have to be settled at the same time. For D.C. machines it is always advisable to have a separate diameter for each length, unless the manufacture is very small indeed. For A.C. machines the same frame and core can be used for two or more lengths of core or different numbers of poles; the longer one can preferably be used for a smaller number of poles than the narrow one.

Commutators.—The length of the commutators should be made sufficient to carry the amperes corresponding to a voltage of 230, with the maximum output allowed for in the standard list. Space has to be allowed on the shaft of the machine for using a longer commutator than standard for very low voltage.

Slip-rings.—It is very advisable to fix these on the outside of the bearings, and to carry the connections through a hole in the shaft. In this way they can always be easily cleaned and inspected, and made enclosed or protected as the case may be. The shaft length between the bearings is not increased, a point which is of great importance, in view of the very small clearance between stator and rotor.

Small Parts.—Small parts, such as terminals, brush-holders, spindles, insulating brushes, will always be arranged so as to be suitable for several types.

Frame.—The frame, made of cast-iron for the sake of quick delivery, should be shaped in such a way as to be suitable for use as a semi-enclosed machine, and for conversion into a protected machine by the addition of small stamped or perforated covers; these will be of the solid type when the machine has to be enclosed. The "enclosed ventilated" machine can be produced without any structural alteration of the standard frame. The "explosion-proof" type requires an entirely special pattern, and cannot be provided for in the standards. Commutating poles are often required. In machines with fairly large diameters it will be possible to retain round poles, which are the most economical as far as weight of copper is concerned. Where the pole-pitch is small, the addition of commutating poles will make the space for the winding of the main poles so restricted that it will be necessary to adopt a square section of poles, and therefore square field spools. The most suitable way to make these poles will then be to assemble them out of laminations, fixing them as well as the commutating poles by machining all round the internal cylindrical surface of the shell, and bolting the poles to it from the outside.

Bearings.—The recognised type of bearings for small machines is the "shield" type. It is advisable to keep both bearings alike, as the saving in using a large and a small bush is hardly worth mentioning. The bushes will be conveniently made of phosphor-bronze; they can, however, be made in white metal for diameters above 3 in. The bolts holding the bearings must be arranged in such a way that the bearing can be turned by 90° or 180° when the motor is required to be fixed to the wall or ceiling; for this reason it will not be advisable to cast the feet of the machine on the bearing brackets. A great advantage will be found in making the two end shields of the machine alike, both for A.C. and D.C. types.

Reduction Gear.—This is often required, and provision must be made in the standard design for it. The best arrangement from the manufacturing point of view is to fix the countershaft of the reduction gear on a separate stool fitted with two bearings, and to mount the motor on this stool. The two bearings can be taken from a standard machine of larger size.

Spider.—The necessity of adopting a spider in the armature has been debated very often, without a definite conclusion being arrived at. There is some advantage in having a spider to which to fix the stampings and the commutator, so that the shaft can be withdrawn at any time, but the adoption of a spider carries with it great inconvenience. From the manufacturers' point of view no spider should be used up to an inside diameter of stampings of 10 in.

Terminals.—The position of the terminals requires some consideration. A good plan is to use independent terminals fixed to small pillars which can be mounted, as a standard way, either on the top or on the side, and can be shifted without great difficulty whenever a special occasion demands it. Another method is not to have any fixed terminals at all, but to end the leads in loose split sleeves, forming sweating sockets for the cables of the supply.

Brush Holders.—The opinions of the users are divided between two classes: one in which the brush-holder is tightly gripped at the end of a long arm hinged on a spindle, and the other in which the carbon is free to slide between two guiding surfaces carried rigidly from the current-collecting gear. It will, therefore, be advisable to arrange for both types of brush-gear to be employed, and so designed as to allow satisfactory running of the commutator in either direction. They should be suitable for different thicknesses of carbon blocks to suit the different voltages.

Standardisation of Large Machines.—The general standardisation of large units cannot be carried out to the same extent as for the small units. It is, however, quite possible to institute a system of sizes independently of any particular output, and to select the most suitable size out of this series when estimating or when executing any order to a specification.

A standard series of direct-current machines is started upon by fixing certain standard diameters of bores, which, beginning with, say, 25 in. or 28 in., will extend up to, say, 120 in., by differences of 4 in. to 5 in. in the smaller sizes, up to 10 in. in the larger ones. In this way one will obtain some 15 different sizes, and as the length of the core can be made of two different dimensions, say, 10 in. and 14 in., the result will be a line of 30 standard types, which should be quite sufficient for ordinary requirements.

In settling the dimensions of the frame, it will be advisable to increase the flux per pole at the same time as the number of poles. As long as commutating poles were not used it was important to increase the number of poles considerably for machines of low voltage. Since the adoption of the interpoles this has become less necessary, as the heating of the commutator is very much less than before, and there is not the slightest difficulty in commutating some 600-700 amperes per spindle, whereas 300 amperes was the average previously. If laminated poles are decided upon, a line of standard dies will have to be arranged to correspond to each armature sector.

The line of commutators will also be settled independently of any output or current. The diameters will be fixed with gaps of 3 in. to 5 in., and an average length of 1 ft. will be taken corresponding to about 300-400 amperes per spindle. Should any additional length be required it will be sufficient to lengthen the rim of the spider of the commutator, which can be done at very slight expense. It is most important to adhere rigidly to the dimensions of the clamp rings, because any change of these will mean a new set of micanite moulds for the V-rings of the commutator.

The bearings of such a line of machines will also be fixed in standard sizes in steps of ½ in. in the diameter. They will be about 2½ diameters in length, and will be fitted with automatic ring lubrication. The best arrangement would be to select a large centre height, so that whenever a smaller centre is required an additional temporary flange is fitted to the pattern and the remaining length is stopped off in the moulding.

The patterns for bedplates can be reduced greatly by settling on standard sections, making up the bedplate in a square with round corners, and cutting it up at right angles into four parts, so that four patterns of the four corners are obtained. By fitting distance-pieces of suitable length, bedplates of any dimensions can be obtained with very little expense. In some instances, for types which are used very often it will even pay to make these standard patterns in iron, in order to prevent deformation.

The brush rocker-gear, which for small sizes can be fixed on the bearing, and which on larger sizes is usually carried from the magnet yoke, can be standardised on the same lines as the shell. It will be necessary to arrange the ring in such a way that more or fewer arms can be fitted to it without inconvenience, and some means of adjustment will also have to be provided for raising or lowering the arms carrying the spindles.

The terminals and cable connections will be easily standardised by selecting a series of flexible cables for all currents up to 600 amperes, and by using 2, 3, or 4 of these in parallel so as to be able to deal with currents up to, say, 2,400 amperes. The respective sockets will be fixed together with suitable insulating bushes, and supported on independent pillars. Any combination of these will then be possible.

For large alternating-current machines a similar system of standardisation can be adopted. A line of diameters is settled upon, but in this case more latitude is allowed on account of the possibility of varying the length of the core without affecting the pattern of the frame of the magnet-wheel. Between 2 ft. and 10 ft. approximately 12 diameters will be found sufficient, the gap between the smaller sizes being approximately 5 in., and the larger ones 12 in. On account of the varying number of poles to suit the various periodicities and speeds, it will be advisable not to make complete dies for the stampings of the stator, but to arrange independent cutting dies for each diameter, viz., one for the inside diameter and one for the outside, so that any combination of cutting dies can be arranged for. The shells themselves will be best made without fixed end-plates, so that these can be shifted further in or out according to the width of the laminations, and without necessitating new patterns or alterations to the core boxes. The poles should be made out of stampings, and here again a line of standard poles can be conveniently designed to suit a number of pole-pitches varying between 7 in. and 14 in., which, assuming a periodicity of 40 or 50, would give all combinations between the very lowest and the very highest speeds, as well as average dimensions for poles for 25-cycle machines.

All the mechanical details such as bearings, foundation-plates, guards, and terminals provided for the continuous-current machines, can be easily worked in to suit the alternating-current machines.

Electrical Considerations.

Most of the arrangements explained previously are really limitations of the freedom in the electrical design. They are, however, necessary for the economical production of the machines and have been recognised as such by all makers. It is clear that there is a great advantage in fixing the number of patterns and tools as far as possible beforehand, and arranging the general charges for them in such a way that they can be distributed over the average number of machines produced during the year.

The stampings of the continuous-current machines should be arranged for one, or, at the minimum, two numbers of slots only, and these can be provided with such a wide range of windings as to cover all practical requirements. The number of commutators for a given type of stampings should not be more than two at the most, and should be arranged in such a way that the higher number of bars can be used for 500 volts with the lowest speed, and, therefore, with the largest number of turns per commutator bar, and the lower number of bars should be still sufficient to give the highest speed at the lowest voltage—*i.e.*, when the number of turns per bar is the lowest. As two commutators for each of the two stampings would represent a stock of four different types of commutators per machine, it will be advisable to arrange the diameter of the commutators so that the same one can be used again in the next larger size of machine. This will be easily possible if the brush rocker-gear is arranged mechanically to fit both the smaller and the larger machine.

It will be advisable to make the commutators of sufficient length for the highest output at 230 volts and to use the same commutator, but with narrower brushes, for 500 volts, as explained previously. For special outputs, or lower voltages than 230, and for higher speeds, an allowance of 30 per cent. on the standard lengths should be more than sufficient. Provision for this extra length must be made in the design of the frame and of the bearing brackets, so that no alteration should be required on the standard shaft.

The fixing of the windings for the different outputs should be done by starting from the best possible average output of the machine, and by systematically trying all possible combinations of coils in the slots, without alteration to the number of commutator bars. The armature coils must, of course, be wound in such a way that the same coil can be connected up in "wave" or "lap" winding, according to the requirements. With one commutator only, a large range of outputs and speeds and voltages is obtainable.

The question of stocking complete armature coils suitable for standard winding is a difficult one to settle, as a stock of this kind has only a limited life. The tape covering after being varnished becomes oxidised and brittle, so that it would be impossible to place the coils in any slot, even with the greatest care, if the coils had been made many months beforehand. As at the same time a certain amount of stock must be at hand to give quick deliveries, it is important to regulate this stock as closely as possible to actual requirements.

The question of the carbon brushes to be stocked is a trying one, as it is only by having a large variety of carbons that sometimes it is possible to work in a type to give a certain output, and in this direction the high conductivity brushes and those made by the Morgan Crucible Co. have done much to help the designer. On the contrary, the brushes with graded resistance also issued by the same company have not met with much success.

The ventilation of the machines will have to be considered very carefully, as the modern high ratings are only possible if the losses are carried away continuously by an efficient flow of air.

In fixing the winding of two or three-phase machines, a suggestion has been made very often regarding the possibility of leaving the coils disconnected, so as to obtain a winding suitable for a large number of voltages by grouping together the poles in one or more parallel circuits, also by bringing out both terminals of each phase and connecting them up on receipt of the order either in star or mesh. Both suggestions are correct, but it will be found in practice that they are only suitable for exceptional cases, because the stocking of a motor

which is not completely wound is not a satisfactory arrangement. The best solution appears to be to wind rotors completely for a given number of poles, and stock the motors in all the components without winding the stator. On receipt of an order the machine can be finished in less than a fortnight, and this will be found quite satisfactory in most cases, especially when a small stock of ready-wound machines is also kept for all normal voltages.

Discussion at Birmingham.

Mr. M. Railing said that all manufacturers would agree on the advantages of standardisation. It aided cheap production by saving capital expenditure, ensured production being concentrated upon proved types rather than experimental types, and enabled existing stocks to be drawn upon in case of breakdown. These advantages all meant increased facilities to the consumer. The question was one of national importance. Those who had to compete against large outputs of well-designed machines coming from the Continent and the United States could only hold their own by standardising as much as possible.

Mr. S. P. Smith said that generally in electrical machinery the material was a more expensive item than the labour, and it would therefore seem that the designer would do well to cut the material as far as possible, at the same time allowing for better workmanship. It would be found that the best possible material was the cheapest. He believed that by the introduction of new insulating materials it would become possible to raise the heating limit in machines considerably, drawing the line at, say, 170° rise instead of 70°. A difficulty in connection with standardisation was due to customers insisting so much on their own specifications. He suggested that it would be better to take the manufacturers' specification and work to that. There was always the safeguard of competition, and if the buyer could not get what he wanted from one maker he could get it from another.

Mr. N. B. Rosher said that, in the case of A.C. machines, there were no less than 16 different frequencies in use in this country. He agreed with the author that, for A.C. motors, the best position for the slip-rings was outside the bearing. The materials of which rings were made was anything but standardised; cast-iron, cast or drawn copper, gun-metal and phosphor-bronze were all being used. For terminals he preferred a cast terminal box which could be secured to a flat face on either side of the machine, and he suggested flexible metallic tubing between the terminal box and the conduit. He believed that the Admiralty were now allowing a temperature rise of the order of 170° in some machines which were being regularly supplied for special work.

Mr. A. E. Gott said that stocking for orders was only possible when everything was standardised. It was surprising how much money was spent, and sometimes wasted, in little defects which greater standardisation would have prevented. In the examples mentioned he thought that the 1,000 and 2,000-R.P.M. speeds for 1-H.P. machines were much too high. He was struck with the extraordinary number of voltages which prevailed in this country and on the Continent. He did not think that manufacturers paid sufficient attention to the details of electric motors, the terminals especially being frequently neglected by the designer. Split bearings were absolutely necessary in certain cases. With regard to reduction gearing, he entirely disagreed with the practice of putting the gear on the top of the motor.

Mr. A. E. Anderson referring to the benefit of keeping one's workmen constantly employed on the same line of work, said that there was a danger that by so doing they were making machines of their men. The same thing applied to the standardisation of designs. It was a very fair question to ask whether that did not tend to the stultifying of invention. He did not agree with the author's statement that for D.C. machines it was advisable to have a separate diameter for every length. He thought they ought to have at least two lengths to get the requisite degree of flexibility, because it was a very difficult matter to standardise armature windings. The same would also apply to the author's statement that the stampings of continuous-current machines should be arranged for one, or, at the maximum, two numbers of slots only.

Mr. Willmot said that what was wanted to start with was correct drawings, but there was very little about drawings in the paper. Also there was no mention of the question of inspection, which was a very important point in standardisation and shop production. Taking machines back to be rectified was one of the things which ran up works costs. For yokes they could now get a very good quality of steel casting at a fair competitive price. With regard to brush-holders, he thought it was better to increase the number of carbon blocks than to increase their thickness.

Mr. Holt said that one of the reasons why standardisation had not been carried to such an extent in electrical machinery as in some other things was that the electrical machine so far had not reached finality. It seemed to be best to design standard machines for ordinary standard voltages, and to treat any departure from these as a case for a special machine. His experience was that wooden patterns had a very short life, and that iron ones, except in very small sizes, were too cumbersome. The outlay on patterns should be kept as small as possible. He had found enamelled wire satisfactory in field coils, where it could be wound in regular layers, but it was quite useless in armatures where it was subjected to a great deal of twisting and handling, and where wires crossed one another at the coil ends. He had had a number of ball bearings running quite satisfactorily, and believed that in many cases their failure was due to faulty mounting.

Mr. Orsettich, in reply, said that Mr. Smith probably meant to say that the specifications of consulting engineers should lay down the principal lines of the design, stating their requirements, but should not insist on small details of construction. If this was what Mr. Smith meant, they were perfectly in agreement, and he believed every consulting engineer would be of the same opinion. In reply to Mr. Rosher, the large number of machines proposed as a basis of standardisation was an essential condition of its acceptance. If the number of standard machines was not sufficiently large, there would be occasion for special machines to be made. As regarded ball bearings, his own experience had been that the balls sometimes broke and the broken pieces damaged the shaft badly before they were found out and removed. He agreed with Mr. Gott that the speed of machines should be kept as low as possible, but there was a large market for high speed machines. With regard to split frames, the general practice was that where the armature become too heavy to be lifted out by two men it was necessary to split the frame. This happened at a diameter of about 14 in. With regard to drawings, he had pointed out at the beginning of his paper that he was not dealing with the question from the shop's point of view, and the same remark applied to the question of inspection. Mr. Willmot's suggestion of altering the number of brushes instead of their thickness was hardly practicable, because it meant increasing the length of the commutator every time the current was increased. As regarded the question of armature stampings, he believed that when the diameter of the centre piece saved by the use of a spider was 10 in. or less, the saving was not sufficient to warrant the use of the spider. A heavy machine with ball bearings had been mentioned in the discussion, but he believed that roller bearings had been substituted in that machine about six months ago.

Discussion at Glasgow.

In supplementing his paper, Mr. Orsettich said his idea was to popularise standardising. If they compared articles turned out in large quantities, like typewriters and sewing machines, with electrical commodities, they would at once admit that they were years behind. The sooner makers could come to some agreement and have some standard adopted generally, the better it would be. He would be glad when he learned that some enterprising independent company had been formed in this country to sell specifications in this connection, as he was convinced that what could be done in this direction with bicycles could be done equally well with electrical fittings.

Prof. Bailey (Edinburgh) said that he was inclined to wonder why, if things were so standardised and co-ordinated, it took months to get a machine from a manufacturer? His opinion was that there was far too little standardisation. Why not cut down the number of sizes? Another point was that dynamo builders offered and stocked more patterns for all sizes of machines than their equipment was able to deal with, instead of specialising upon a limited range of machines where they could get advantage of a large output and diminish the number of patterns. If they started a particular size, that size would grow into their business. Why should that which was done in other business lines not be done with equal success in the electrical business?

Mr. Campbell McMillan said that the point which chiefly interested him was the attempt to obtain standardisation through a better understanding between those concerned in the manufacture, production and distribution of electrical machinery. The point had been raised again and again, and sometimes on lines similar to those of the author. The right compromise between the manufacturer and the customer was to come to an arrangement by which the latter would get exactly what he wanted if he paid for it as near as possible what it cost to produce. If a manufacturer went out of his way to express himself in clearly understood terms he might do a great deal more to educate a customer than was done at the present time.

Mr. J. R. Burr pointed out that the paper referred more closely to small motors below 100 H.P., but in the case of direct-current motors and rotary converters standardisation might be carried still further, for the same machines might be used either for rotary converter or for dynamos.

At the close the author indicated that he would reply at length through the *Journal*.

Rating and Testing of Motors for Intermittent Working.

(*Discussion on paper read by* Dr. R. Pohl, *before the* Institution of Electrical Engineers *at Sheffield, March 16th*, 1910. *See* Electrical Review, *April 8th, p. 572.*)

Mr. Wilson Hartnell, in opening the discussion, said the ordinary testing of enclosed motors was most unsatisfactory, and the statements regarding them made by various makers were misleading. The difficulties of obtaining a formula or mode of testing that would enable the final temperature of an enclosed motor to be predicted from a brief test seemed almost insuperable, on account of the many unknown variables of almost equal importance. He had investigated this subject from an experimental point of view, and given some of the results in a paper on "The Heating of Enclosed Motors," some time ago (*Proceedings* I.E.E., Vol. 41, 1908). He thoroughly agreed with Dr. Pohl wherever he had touched on practical points, especially regarding the heating and cooling curves. He had found that although the heating and cooling curves of different sizes of motors had a general resemblance, they were far from identical, and he was forced to the conclusion that no large totally enclosed unventilated D.C. motor could be run at full load continuously. Having experimentally obtained a complete standard curve for a given motor, the test of a similar (or nearly similar) motor need only be carried far enough to obtain the tangent, and, say, three points in the heating curve. The complete curves could

then be surmised, and drawn from the standard curve. By these means the behaviour of an enclosed motor under all ordinary circumstances could be demonstrated from a short test, with sufficient accuracy for all practical purposes.

Mr. A. J. Cridge said it was not immediately obvious why the ratio mentioned should be the load factor. It seemed to him that if the area of the current curve as taken on a recording ammeter were divided by the area of the rectangle representing the product of the maximum current and the total time, the ratio would correspond more nearly to what was generally called load factor. He agreed with Dr. Pohl that the present practice in regard to the testing of motors for intermittent use was not satisfactory, and he thought that the Institution ought to take the matter up and lay down some rules not only for this but for other testing work. This had been done in America, and the rules seemed to be of the greatest possible use to electrical engineers there. There seemed, however, to be a feeling that it would lower the dignity of the Institution to deal with any particular subject; it must indulge in generalities. He did not think this attitude was helpful to the profession. The time constant of a motor seemed to vary with almost every conceivable condition. It was a question whether such a quantity as this ought to be regarded as a constant at all

Mr. J. C. B. Ingleby said it was not easy work to predetermine the ratings of this class of motor; the method of circulating the air inside the motor had a great deal to do with the temperature rise in totally enclosed machines, for instance, taking a 20-h.p. motor with a one-hour rating and a speed of 775 r.p.m., if this motor were rated for half an hour the speed could drop to about 510 r.p.m., or for a quarter-hour rating to about 350 r.p.m. The temperature coefficients mentioned by the author would take quite a lot of finding.

Mr. H. E. Yerbury said that, in his opinion, it would be advisable to dissociate traction motors for tramways from such admittedly intermittent types as crane, hoist and lift motors. Now that electric braking was being used to such a large extent in tramway work, one could not look upon motors for traction work as machines for short-period working. In the case of traction motors, the usual period of test was four hours, full load, but for crane and lift work a shorter test would be satisfactory, especially if it were a full-load continuous one. His experience of troublesome motors had invariably revealed overheating and consequent failure of insulation. This applied to traction and other motors. He agreed with the author that there should be an established basis of rating and testing for all machines, but manufacturers should always be in a position to quote to an engineer's specification respecting, say, temperature rise for a certain machine working under exceptional conditions.

Mr. W. T. Wardale said he believed the auxiliary motors on the battleships of the Navy were tested as intermittently working motors, and a half-hour test was misleading, because if they took the motors working in connection with ammunition hoists on these ships, in the event of a long-fought action the temperature of the whole ship would go up tremendously; further, every shot which the ship received would of course strain to some extent the whole ship's framework, and it was quite possible that the guides on which the hoists ran would be jammed. If these motors gave out at a critical time, it would be a serious matter. Designers who ran as near the wind as they dared by using cast-iron yokes, in the long run would reap what they deserved, because such motors would get classed as those that might stand the test on the test plate but would not do the work outside. He would like the author to test in the ordinary way on the test plate a set of motors for a crane, and afterwards equip a crane with these motors. If this was done under a full working day, some relation might be established between the practical working conditions and test plate conditions which might be valuable.

Dr. Pohl, in reply, said, as regarded Mr. Hartnell's suggestion that a series of tests should be carried out to ascertain exactly the heating and cooling curves of a number of motors, that he had taken a number of such curves for d.c. and a.c. machines both of the totally enclosed and open type, but did not include them in the paper because a fair amount of information had been published on these lines, for instance, in Goldschmidt's paper to which reference was made. If they knew the time constant for running at a certain speed, they could draw the whole of the heating curve, and if they knew the time constant for cooling they could draw the cooling curve. If they had then an intermittent load, with any given load factor they could construct a curve such as shown in the paper, and it would almost exactly represent what they obtained in practice. But they had to find what the time constants were by experiment. Such procedure was far too complicated to be adopted as a standard test for intermittently working motors. What was wanted was one simple test which gave the required information directly, and that was the essence of his paper. His experience agreed with Mr. Hartnell's in that three-phase motors, when totally enclosed, showed more satisfactory results, comparatively speaking, than d.c. machines, owing to the cast-iron casing being in close touch with the stampings which are the seat of a great part of the losses, and also to the very small gap between stator and rotor which facilitated the rapid transfer of the heat from the interior to the surface. His definition of the load factor was put forward as a suggestion; it was largely a matter of choice what definition one adopted, so long as it was clearly understood what was meant. It was not much good putting a fan into a totally enclosed motor; at the same time, however, it would be wrong to deny that the circulation of air inside the casing had something to do with the heat dissipation of the armature. Traction motors and crane motors could be treated in the same manner; heavier duty simply meant that the specified load factor for which they must be tested was correspondingly higher. Some large railway motors which the Phœnix Dynamo Manufacturing Co. recently supplied for most onerous duty on express passenger trains, were in accordance with the specification designed and tested for load-factor unity—that meant for continuous running on full load. The purchaser should specify a load factor which corresponded not to the normal but the heaviest possible duty. Manufacturers could not be expected to test motors above what was specified. He could confirm that motors for ammunition hoists for the Navy were specified to be tested intermittently for a great length of time. A large number of machines were special ones, and were in consequence more expensive, which need not be special at all; this was due to the absence of rules on the rating and testing of machines backed up by the authority of the Institution of Electrical Engineers. He failed to see why the Institution should not proceed to remedy this serious defect, which weakened English manufacturers in home and foreign markets, in their competition with Continental and American rivals.

PARLIAMENTARY.

Devonport and District Tramways Bill.

A Select Committee of the House of Commons, under the chairmanship of Sir J. Compton Rickett, was engaged for three days in the consideration of the Devonport and District Tramways Bill. At present the company lease the tramways from the Corporation on the following terms: (*a*) The payment of the sum of £2,176 6s. 8d. yearly, being a sum calculated at the rate of 3½ per cent. on the capital expenditure of the Corporation on the construction of the tramways (£62,180 18s. 10d.); (*b*) The payment of £1,306 19s. 11d. annually, being such a sum as will, with accumulated interest, pay off the capital expenditure within 30 years. There is also a proviso that the reasonable cost of the concrete and the laying thereof on the Camel's Head Embankment, and the reasonable cost of improving the gradient of Milehouse Hill, when such cost has been incurred by the Corporation, shall be added to and deemed to form part of the capital expenditure of the Corporation, and that for the purposes of computing rents (*a*) and (*b*), the amounts of such rents are to be increased accordingly; (*c*) The company is to pay £213 11s. 1d., being a yearly rent computed at the rate of £50 per mile of route of the Corporation tramways; and (*d*) the annual sum of £200, being a contribution to the cost of reconstructing Camel's Head Bridge. The proposals in the Bill were (1) that in lieu of rents (*a*) and (*b*), the company should, during the continuance of the lease, pay the net revenue accruing from the Corporation tramways to the Corporation after payment of working and other charges, and for this purpose the accounts of the lines owned by the Corporation were to be kept separately from the other lines; (2) that the company should be relieved from all liability in respect of Camel's Head Embankment and the gradient of Milehouse Hill; (3) the company should be relieved from all liability to pay rents (*c*) and (*d*). There were also further proposals with regard to the running of early tramcars, &c.

Mr. J. D. Fitzgerald, K.C., Mr. E. H. Lloyd, K.C., and Mr. Shaw were for the promoters, whilst the Devonport Corporation was represented by Mr. Danckwerts, K.C., Mr. G. J. Talbot, K.C., and and Courthope Munroe.

Mr. Fitzgerald said the powers to construct about 4¾ miles of tramway in the borough were acquired by a body of gentlemen in 1898, but the British Electric Traction Co. eventually acquired the rights, and a company was formed and the lines opened for traffic in 1901. The cost of constructing the lines, including Parliamentary costs, was £140,000. In 1898 the Corporation promoted an order for the extension of their boundaries, and when the matter was before the Local Government Board, they promised to construct a tramway to St. Budeaux as an inducement to the inhabitants of that district to come into the borough, and having got their Extension Order, the Corporation in 1900 promoted a Tramway Order, and obtained authority to construct tramways from Milehouse to St. Budeaux. The Corporation then began to look about to see how they could carry out their promise to construct the line, and they began to put pressure on the tramway company to agree either to construct the lines, or to lease them.

Answering the Chairman, who expressed surprise that the Corporation should have taken up the scheme so quickly on the heels of the company, Counsel said he did not think the Corporation negotiated with the company previously. The fact was that the extension of the boundary was severely contested, and the Corporation offered to make the tramway to St. Budeaux.

The Chairman said it would not have mattered to the St. Budeaux people who made the tramway as long as they got it.

Mr. Fitzgerald said the company did not want to make it. At this particular stage the company were not consulted as to the tramway schemes of the Corporation, but afterwards they were pressed by the Corporation to lease and work the tramways. When the company said they were not willing to do this, the Corporation said that they had had a definite offer from another quarter to construct the tramways which had been authorised and also, with the assistance of the Corporation, to construct other additional tramways, which would be in competition, and that, if the company did not agree to take a lease of the tramways, then the Corporation would probably agree with the other party.

The Chairman asked what particular form of screw the Corporation

could put on the company. Did the local authority have the power to construct these additional tramways, or would they have to get them?

Mr. Fitzgerald explained that the Corporation had in 1899 and 1900 obtained actual powers to construct these tramways to St. Budeaux. They had not at the time got powers to construct the additional lines with which they threatened the company, but they said they would obtain the necessary powers unless the company took a lease of the authorised lines. Counsel proceeded to read letters from the late town clerk to the company, dated August, 1901, in which he referred to the offer of the other party. At the end of 1901 the Corporation promoted a Bill taking powers to run over the company's lines, and they also inserted in the Bill some very hostile provisions with regard to the existing powers of the tramway company. Seeing the probability before them of an expensive Parliamentary fight, the tramways company ultimately agreed to take a lease of the extension and to work it on very onerous terms, which turned out disastrous.

The Chairman asked what became of the Bill.

Mr. Fitzgerald said the company agreed to take the lease, and the hostile provisions were struck out. Every effort had been made to discover who it was that made the offer to the Corporation to construct and work these competitive lines, but without result. The town clerk undertook to produce any document he found with regard to the offer, but it now appeared that it was not to be found in the municipal archives of Devonport. Not only had it been lost, but nobody could tell from whom it came. The then town clerk said he could not remember from whom it came; the mind of the chairman of the Committee appeared to be a blank, and the other members of the Committee were in a similar position.

The Chairman asked how the discovery of this offer was pertinent to the present application?

Mr. Fitzgerald thought it was important as throwing light on the pressure brought to bear upon the company on what appeared to him to be very insufficient grounds. The only record which appeared was the following entry in the minutes of the Tramways Committee of the Corporation on August 20th, 1901:—"Read letter dated July 10th, 1901, containing an offer from a quarter which it was deemed advisable should not be made public at the present time, to lease from the Corporation the St. Budeaux line, together with the lines authorised by the Devonport Corporation in 1900 on terms therein stated. Consideration of the matter was adjourned pending the receipt of a communication from the Devonport District Tramways Co. in reply to a letter written to the company by the town clerk." The only person who apparently knew anything about the matter was Mr. Pilling, the late town clerk, who was now clerk to the Metropolitan Water Board.

Mr. Danckwerts said Mr. Pilling was unable to call to mind the name of the party making the offer.

The Chairman said that according to counsel his clients apparently acted on the shadow without knowing what the substance was.

Mr. Fitzgerald pointed out that they were under two threats at the time. The total rents demanded by the Corporation were £3,897 for the extensions, and the result had been absolutely disastrous to the company. So long as the company were working their own lines only they did very well, and in 1902 and 1903 they were able to pay dividends of 4 per cent. The extensions were opened in 1903 and 1904, and although then the prosperity of Devonport was at its highest point, the dividend fell to 2 per cent. Since then the company had ceased to pay a dividend, and now, after making allowances for depreciation, the tramways were being carried on at a loss. The extensions only paid working expenses, and consequently the heavy rent had to be earned on the company's own line. Unless something was done the company would be driven into a position of absolute insolvency. The company had to renew the pavement between the lines, and here again the result was disastrous, because the Corporation had not used granite setts. Further, the company had to take its current from the Corporation, and had to pay about 1·7d. per unit on a supply of 900,000 units a year. The agreement ran till 1926. The company was worked most economically, and gave a good service to the public, and 40 per cent. of the traffic was carried at workmen's fares. Things were going from bad to worse, and the only result could be bankruptcy. In March, 1908, the company asked the Corporation to grant concessions or to purchase the undertaking, but they refused.

Some discussion took place on the point as to what the company charged the Corporation with, and Mr. Fitzgerald said he did not suggest that there had been no offer from another party to the Corporation, but he thought that the offer was made too much of to bring pressure to bear on the company.

The Chairman: May I put your case this way. Your company is not financially successful. You say Parliament is bound to protect you, and that you obtained powers from Parliament, and they have not been a financial success.

Mr. Fitzgerald said the powers were granted to public advantage. An agreement was entered into with a limited knowledge of the facts and has turned out to be absolutely disastrous to the company. Proceeding, Counsel said that as the Corporation refused to meet them the company stopped the extension tramways after the Christmas holidays in 1908. A conference took place at the Board of Trade but nothing could be arrived at.

The Chairman asked if the Corporation had done anything to enforce the agreement.

Mr. Danckwerts said there had been a number of actions in the Court, and the company were worsted every time.

Mr. Fitzgerald said the Corporation issued 155 summonses against the company, although he saw no reason for issuing more than one. The company came to the conclusion that it was impossible to come to terms with the Corporation, and so they promoted the Bill.

The Chairman: Having been outlaws for 18 months you come to Parliament. He asked whether the company had any evidence to show that if all these complicated amendments were agreed to they could go on.

Mr. Fitzgerald said he thought he could prove that they would be able to go on to the end of the term of the lease.

The Chairman: I suggest it would put you in a better position to negotiate with the Corporation. Is not the whole application to enable you to negotiate on more equal terms with the Corporation, and that you do not contemplate going on at all?

Mr. Fitzgerald said they had been asking for concessions for two years, and they now asked for concessions which would enable them to go on to the end of the lease. They could have a new agreement, or the Corporation could take over the concern, but if they were driven into liquidation, they would have to sell their undertaking to the Corporation for any sum they liked to fix. If they were able to continue to 1926, then they would have their property in their own hands, and the Corporation might, if they chose, purchase it at its structural value, less depreciation. Counsel concluded by dealing with the petition of the Corporation against the Bill.

Mr. W. Bond, chairman of the company, stated that the shares were nearly all owned by the British Electric Traction Co.

The Chairman suggested that the parties might confer together, as the case looked like one for mutual concessions.

The case was accordingly adjourned till the following day, but on reassembling it was stated that no settlement had been arrived at, and a further adjournment took place.

On Friday, April 8th, the Committee again sat, and evidence was given by Mr. Raworth, a former chairman of the company, as to the agreement entered into with the Corporation.

The Chairman said the Committee were satisfied that the agreements were freely entered into after ample discussion.

After a further adjournment and a consultation in private by the Committee, the Chairman announced that the Committee felt it would be waste of time to go on further, as on their own showing the promoters had failed to make good their case.

Mr. Talbot applied for costs on behalf of the Corporation, and urged that his clients had been put to unreasonable and unnecessary expense to defend their rights.

After legal argument the Committee refused to allow the Corporation any costs.

Wimbledon and Sutton Railway.

(*Concluded from page* 622.)

The first witness on Tuesday last week was Sir John Wolfe Barry, who said he was a member of the Royal Commission on London Traffic, and one of their recommendations was that the suburbs should be brought more into direct contact with London. The terminal station of the great railway brought the people to one particular spot, and from there the people had to find their way to the various places they wanted to get to. The scheme of the promoters would enable a person to get to any part of London without unnecessary interchanging. In his opinion the connections which were available to the proposed railway would be of great benefit in enabling people to get to various parts of London.

Do you consider that the junctions at Wimbledon are well arranged?—Yes.

Do you consider, speaking generally, that the scheme from an engineering point of view is well conceived?—Yes.

Continuing, Witness said that another recommendation of the Royal Commission was that land which was available in different outlying parts should be developed by means of railway facilities. This the proposed railway would undoubtedly do. The gradients and curves on the lines were not unusual. As to the objection of the Brighton Co., if their contention that they did not want the line near them at the Sutton end because they might want to widen their station was a *bona fide* one, the promoters could easily construct their station without interfering with the Brighton Co.

Replying to Mr. Page, K.C., for the South-Western Railway, Witness said it was to the advantage of everyone to develop through traffic. The more traffic the South-Western Co. got the more profit they got.

Mr. W. R. Cooper, M.Inst.C.E., M.Inst.E.E., gave similar evidence.

Cross-examined by Mr. Clode for the Brighton Co., Witness said that the gradients and curves on the proposed line were steeper and sharper than on the District Railway. They were, however, differently placed. The gradients and curves were near stations, and that made all the difference. There were more numerous curves on the proposed railway than on the District. He knew of a case where gradients had been held to be against the efficient working of a railway.

Mr. L. R. Vigers, surveyor, said that the estimates were ample. They provided £130,000 for the acquisition of land and compensation, of which £500 was for the pathway at Sutton connecting the line with that of the Brighton Railway. The estimates worked out at an average of £22,600 per mile.

Mr. R. H. Selbie, general manager of the Metropolitan Co., gave statistics as to the development of land caused by the construction of a railway. As an instance, he mentioned that of the Putney to Wimbledon extension, where, since the line had been constructed in 1890, there had been an increase in passengers carried of 394 per cent.

Sir George Gibb, chairman of the District Co. and other railway companies, said that the line would be an advantage to his company. They had no financial interest in the line, and had not been asked to put any capital into it.

Mr. Clode pressed witness as to whether the District was not at present overcrowded morning and evening, and yet it was proposed to cater for this extra traffic which the projected line would bring.

Sir George admitted that at times the trains were "comfortably crowded." He knew complaints had been made to the Board of Trade, but there were certain people who were never satisfied with the provisions that were made. They at present could run 36 trains an hour, but he thought they might possibly work up to 40. There was no actual agreement between his company and the promoters as to the working of the line. It was proposed that the District should run it as a natural extension of their railway.

Mr. Faithful Begg, a member of the Stock Exchange, said he thought the capital could be easily raised. He had no doubt that, if the Bill passed, his firm would arrange for some of the capital to be provided.

In answer to Mr. Freeman, Witness said he did not come with any guarantee that his firm would raise the capital.

Mr. A. H. Stanley, general manager of several electrical tube railways, having given evidence, the case for the promoters closed.

The opposition of the Brighton Railway was then proceeded with.

On Wednesday last week, Mr. C. L. Morgan, M.Inst.C.E., engineer-in-chief to the Brighton Co., was the first witness. He said he agreed with the promoters that the line, as it was being worked by electrical power, could have sharper curves and steeper gradients than on an ordinary railway. The ordinary trains of the London and South-Western Co. could not run on it—the line was only suitable for electrical purposes. He could not agree with the estimates of the promoters. In the deposited Parliamentary plans provision was made for 16 bridges at an estimated cost of £37,400, and there were certain accommodation bridges and work, for which £4,787 was allowed for, and £2,713 had been provided for connecting roadways. That was a total estimate of £44,890. Since the depositing of the plans, the promoters had promised 26 bridges, as against 16, and the cost of them he estimated at £75,511. There was a deficiency on the estimates of £30,621, or an increase of 28·8 per cent., according to his calculation. As to the junction with their line at Sutton, there were physical difficulties in the way. It would militate against the proper working of their traffic.

Mr. Freeman: It would not be convenient to the Brighton Railway?—No; possibly harmful.

Can you understand what they want a junction for?—Not at all. So far as the railway at present is concerned, I can see nothing in it.

Mr. Lloyd, in cross-examination of witness, put it to him that, if the Brighton Co. contended that they did not want the junction, the promoters were prepared to abandon the proposal.

Witness said he understood that the Brighton Co. did not want the junction.

Mr. Lloyd said that they had asked powers for it, in case Parliament should consider it was necessary in the public interest.

Witness, replying to a question by a member of the Committee, said he would not say that the line could not be worked with safety by steam power owing to the sharp curves. They would have to run considerably shorter trains than was usual if steam power was used.

Mr. Freeman addressed the Committee on behalf of the Brighton Co.

The case for the opponents of certain property in Sutton was then put before the Committee by Mr. Courthorpe Munrow. The witnesses contended that the line would develop a certain class of residents who were not desirable.

The London and South-Western Railway Co. then called witness in support of their opposition.

Mr. J. Vickery, chief assistant general manager to the L. and S.W. Railway, said that he had examined the plans, and in his opinion the proposed junctions with his company's lines were not convenient ones. He had no doubt that they could be arranged to meet the views of his company. If the Bill passed, a clause should be inserted in it providing that proper connection should be made at the expense of the promoters to the reasonable requirements of the South-Western Co.

Mr. Lloyd, K.C., for the promoters: You do not want the opportunity to slip of having a junction with our line?—Certainly not.

Mr. J. W. Jacomb Hood, engineer to the company, gave similar evidence, and went into the engineering details. The present junctions as proposed were physically impossible.

Sir Charles Owen, general manager of the London and South-Western Railway, giving evidence on Thursday, denied that there was any agreement in writing between his company and the Brighton Co. to oppose the Bill. There was a sort of friendly feeling between them as to the protection of their interests.

Mr. Page, K.C., addressed the Committee on behalf of the South-Western Co. He contended the promoters had not made out the public necessity for the Bill, which could only do incalculable damage to the South-Western Co.

Mr. H. Lloyd, K.C., replying for the promoters to the criticisms of the opponents to the Bill, claimed that he had proved by evidence that the residents and landowners of the district through which the proposed railway would run were in favour of the scheme. The London and South-Western Railway adopted the same attitude as they did when the extension of the Putney to Wimbledon line was proposed. The general manager said it was an insane idea, as it would run through green fields, yet to-day that district was thickly populated, and the line had proved a remunerative one to the South-Western Railway. As to the objection of the London, Brighton and South-Western Co., they said that the capital would never be raised. If that was so, what had they to fear from the competition, for if the money was not raised how could the line be constructed? The promoters had agreed to abandon the proposal to construct the junction, and they would not take any of the land required by the Brighton Co. As to the South-Western contention that the junctions at Wimbledon were useless, they had been put in at the suggestion of that company's engineer. The original Bill did not contain any proposals for a connection with the South-Western Co. He asked the Committee to pass the Bill which he submitted would be remunerative to all concerned, and of enormous benefit to the public.

Having deliberated in private,

The Chairman said the Committee had decided to allow the Bill to proceed subject to the following conditions:—The junction with the South-Western was to be by agreement or failing that by arbitration. They did not insist on the junction with the Brighton Co., but public means of access must be provided between the two stations at Sutton. The South-Western Co. were to receive a sum not less than they did at present from the user of the terminal station at Wimbledon. They would not, therefore, suffer any injustice by reason of the trains running through.

In reply to Mr. Ram, K.C., for the promoters, the Chairman said that Railways No. 2 and 4 (junctions with the South-Western Main Line) were to be constructed by agreement or arbitration. Railway No. 1 (connection between the promoters' line and the District) would be constructed according to the provision in the Bill. The Committee did not insist on the construction of any junction.

Leeds Corporation Bill.

Lord Ritchie's Select Committee of the House of Lords on April 14th had before them the Bill promoted by the Leeds Corporation, the chief proposals in which related to the provision of the trackless trolley system of tramways. Mr. H. Lloyd K.C., Mr. C. C. Hutchison and Mr. Jeeves were for the Corporation. Mr. Balfour Browne, K.C., and Mr. F. G. Thomas represented the Lancashire and Yorkshire Railway Co.; and Mr. C. J. Talbot, K.C., and Mr. J. Shaw the Midland Railway. Other opponents reserved counsel.

Mr. Lloyd, in opening the case, said the Bill was a simple one, although there was a certain amount of novelty about it. The object of the Bill was to enable the Corporation to run vehicles by means of electrical power without rails. The tramways undertaking of the Corporation was carried on under very favourable circumstances, and although the fares were low the result was a considerable profit devoted to the relief of the rates. The Corporation had frequently received applications from people in outlying parts of the city for tramways, but it had been impossible to accede to the request owing to the cost of construction. Deputations had been sent to the Continent, where the system of trackless cars had been developed, and where they were a great success. The advantage of the system was in not having to lay down a track. It was anticipated that the cost of working would be about 1d. per car-mile less than with the present tramways system. There were also the advantages that the equipment was almost identical with the tramway equipment, so that if after setting up the trackless system, it became apparent that the route would bear the ordinary tramway undertaking, the rails could be laid down, and tramcars substituted for the trackless car. It was proposed by the Bill to obtain powers to establish the system on a particular route, pending the arrival of the time when the traffic would justify an ordinary tramway service being instituted. They were also asking by the Bill to run trackless cars upon any routes in the city, which the Board of Trade might hereafter approve, and if these cars were authorised, that they might be used as part and parcel of the tramway system to carry goods. Leeds already possessed the power to carry goods on the whole system. There was nothing in the Bill about the carriage of goods, but, of course, if the trackless system was made, as the Corporation asked, part and parcel of the whole system, the general powers as to goods would apply.

Mr. Balfour Browne said that was his whole point. It meant that by a side wind, as it were, the Corporation would get power to carry goods on any trackless car route which might be approved by the Board of Trade.

Mr. Lloyd pointed out that the Board of Trade would take all those matters into consideration when applications were inquired into, and opponents would have the opportunity of being heard.

Mr. J. B. Hamilton, general manager of the Leeds City Tramways, said there were 57½ route-miles of tramways and 106 miles of single track, which passed outside the city at three points. The total number of passengers carried in 1908-9 was 76 millions, whilst over 78 millions were carried in the year just ended. As the result of the investigations of the deputation, which had inquired into all the systems of railless traction, they were satisfied that the cost of installation would not exceed 25 per cent. of that of the overhead system, and the reliability and cost of operation were practically the same. The Tramways Committee were much impressed by the possibilities of this method of supplying efficient services for thinly populated districts. The route proposed was from the City Square, *via* Wellington Street, Aire Street and Whitehall Road to the city boundry near Drighlington. On a portion of this route powers to construct a tramway had been obtained and put into operation, and it was intended to run over this section, and to use the present standards and brackets for the

purpose of carrying the additional wires. In 1902 powers to construct tramways along the Whitehall Road were obtained, but the tramways were not constructed, and it was considered that the present proposal would serve the district equally well. The length of the route was about 4½ miles. He considered the tramway would prove profitable on the route, and it would also serve as a test to show whether the traffic warranted the laying down of a rail track. There were no engineering difficulties on the route. Leeds proposed to adopt a system similar to the one controlled and operated by the municipality of Vienna. He calculated the total working cos's at 6·12d. per car-mile and the receipts 6⅔d, and the net result would be that whereas the loss on an ordinary tramway would be £3,000 a year, the trackless system would result in a profit of £450. With regard to the request for general powers to establish the system on routes approved by the Board of Trade, the object was to avoid the heavy expenses of seeking for Parliamentary powers, which in the case of short routes, would prove a very serious obstacle. He did not think it could be said that the system was in an experimental stage, and there was no reason why the cars should not prove as reliable as ordinary tramcars. He considered that trackless cars were less dangerous than motor-omnibuses, because the weight of the car would be more evenly distributed.

The Chairman asked what the experience was on the Continent?

Witness said that trackless cars were operated along, what in England would be termed narrow country roads, and the vehicles passed each other just like ordinary vehicles on the road.

Cross-examined by Mr. Talbot as to the proposed carriage of goods, Witness denied that it was the intention of the Bill to help to develop such traffic.

Following a consultation by counsel the Committee adjourned, and, on a resumption of the proceedings,

Mr Balfour Browne announced that a settlement with the railway companies had been arrived at. The Corporation had agreed to the following addition to the clause:—"Provided that such omnibuses (*i.e.*, the trolley cars) shall not be used for conveyance of goods and minerals, except such traffic as arises in and is destined for places within the City, and excepting passengers' luggage conveyed with the passengers." Provision would also be made for the cutting off of the current to allow for the repair of railway bridges under which the trolley wires passed.

The Committee thereupon passed the preamble, and ordered the Bill to be reported for third reading.

Mersey Railway Bill.—The Bill promoted by the Mersey Railway Co. came before Mr. Emmott's Committee on Unopposed Bills on Thursday, April 14th. The Committee ordered the Bill to proceed for third reading.

Nottingham Corporation Bill.—This Bill passed its third reading in the House of Lords on Tuesday. The Corporation propose to construct additional tramways and to widen certain streets, and the Bill extends the period for the construction of tramways authorised in 1905. The estimates give £24,000 for tramways and £9,259 for electrical equipment.

Radio-Telegraphic Apparatus on Ships.—In Friday's Parliamentary Papers, Mr. Lonsdale asks the President of the Board of Trade whether his attention has been directed to the legislation contemplated in some foreign countries with the view of requiring ocean-going passenger steamers to be equipped with efficient radio-telegraphic apparatus; and whether it is in contemplation to introduce legislation to require British vessels to carry such an equipment. —Mr. Buxton replies that his attention has been directed to the legislation on this subject which is contemplated in certain foreign countries A large and increasing number of British vessels are voluntarily fitted with radio-telegraphic apparatus. Compulsory legislation at the present moment would, he thought, be premature, but the matter will be carefully watched.

Reading and District Electric Co.—This Bill passed its third reading in the House of Lords on Tuesday. Mr. Seager Berry, of Messrs. Sherwood & Co., Parliamentary agents for the promoters, explained that it was proposed under the Bill to extend the area of supply so as to include Caversham, Goring, Tilehurst and Theale. Powers were also asked to supply electricity in bulk to authorised distributors in the districts of Wokingham, Bradfield, Wallingford and part of Henley. Formal evidence having been given in support, the Bill was ordered to go forward.

Metropolitan Railway.—This Bill was read a third time in the House of Lords on Monday. Under this measure the company ask power to construct a subway under Edgware Road, and in conjunction with the City and South London Railway and the Great Northern and City Railway Companies to make two subways between the respective stations of the three companies at Moorgate Street. Further powers are sought to extend the time limited by the company's Act of 1902 for the completion of works at Baker Street station; to authorise the company to acquire additional lands, and to enter into working agreements with the above-named companies. No capital powers are asked for.

Charing Cross, Euston and Hampstead Railway.—On Wednesday last week, Mr. Balfour Browne, K.C., said that negotiations have proceeded between the promoters and the proprietors of the Hotel Metropole, and an arrangement had been come to. That was that the proposed tunnel should be removed further from the hotel, but another difficulty had arisen. The new proposal would involve their going under the S.E. Railway Co.'s bridge at Charing Cross, and Mr. Clode, counsel for that railway company, could not say whether they would object. The promoters thought it best, therefore, to withdraw the proposal to extend the line. The Chairman complained that the promoters had stated that it was impossible to have an alternative scheme, yet they now proposed one. Mr. Balfour Browne said the alternative plans had not been prepared when that statement was made.

Post Office Sub-Engineers.—Mr. Wiles asks the Postmaster-General if he will state the source from which he intends to obtain recruits to fill the 36 vacancies now open in the sub-engineers' (probationary) class in the department of the Engineer-in-Chief. Mr. H. Samuel replies that the class of sub-engineers will be recruited by competitive examination among officers serving in the Post Office. He is unable to announce the regulations yet, but hopes to do so shortly.

Third Readings.—The following have passed their third reading in the House of Lords this week:—London Electric Railway Amalgamation Bill; Yorkshire Electric Power Bill; Metropolitan District Railway Bill.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

Amendments

BELGIUM.—A Bill has recently been introduced in the Belgian Chamber of Representatives by the Minister of Finance in which certain increases in the duties leviable upon imported merchandise are proposed. One of the proposals is to raise the duty on electrical machines of cast-iron from the present rate of 2 fr. per 100 kg. to 4 fr. per 100 kg.

BRITISH HONDURAS.—An Ordinance dated February 17th, 1910, provides for the increase of the general duty on all goods unenumerated in the Tariff from 10 per cent. to 12½ per cent. *ad valorem*. The statement of duties in British Honduras given in the Electrical Review of January 22nd, 1909, must accordingly be revised.

NEW PATENTS APPLIED FOR, 1910.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford, to whom all inquiries should be addressed.

8,042. "Improved means for the devulcanisation of india-rubber compounds and reclamation of pure rubber by electro-chemical action and deposition under pressure thus generated." E. M. Bailey, T. Middleton and B. Bailey. April 4th.

8,049. "Improved means for the vulcanisation of india-rubber by the use of cold electro-chemical action under pressure thus generated." E. M. Bailey, T. Middleton and B. Bailey. April 4th.

8,076. "Improvements in or relating to controllers for electric motors." T. von Zweigbergk. April 4th.

8,080. "Improvements in electric switches." A. P. Lundberg, G. C. Lundberg and P. A. Lundberg. April 4th. (Complete.)

8,125. "Improvements in means for starting alternate-current mercury-vapour lamps." W. C. Heraeus G.m.b.H. (Date applied for under Sec. 91 of the Act, January 17th, 1910, being date of application in Germany.) April 4th. (Complete.)

8,126. "Improvements in connection with shunt circuit-tilting devices for mercury-vapour lamps." W. C. Heraeus G.m.b.H. (Date applied for under Sec. 91 of the Act, January 24th, 1910, being date of application in Germany.) April 4th. (Complete.)

8,141. "Semi-bridge duplex (electric telegraphy)." J. Kajiura. (Date applied for under Sec. 91 the Act, April 6th, 1909, being date of application in Japan.) April 4th. (Complete.)

8,150. "Silver-plating solution." S. Warne. April 5th.

8,155. "Single-pole double battery system of automatic electric supply for motor-cars and the like." R. F. Hall. April 5th.

8,167. "Method of enclosing the arc of arc lamps." J. W. Nasmith. (T. L. Carborne, Germany.) (Application for patent of addition to No. 17,448/09.) April 5th. (Complete.)

8,219. "Improvements in reversible variable speed dynamos." H. Leitner. (Date applied for under Rule 13, July 31st, 1909. An invention comprised in application No. 17,847, dated July 31st, 1909.) April 5th.

8,225. "Improvements in electromagnetic breakers and means for resetting the same from a distance, and in signalling devices combined therewith." Adams Manufacturing Co., Ltd. (Cutler-Hammer Manufacturing Co., United States.) April 5th. (Complete.)

8,225. "Improved switch for use on motor-cars lighted by electric lamps." H. Taylor. April 5th.

8,228. "Improvements in and relating to automatic telephone exchanges." E. Neuhold. (Date applied for under Sec. 91 of the Act, June 10th, 1909, being date of application in Germany.) April 5th. (Complete.)

8,257. "Improvements in or relating to electric sparking plugs." R. W. Ayton. April 6th.

8,274. "Improvements in rheostats." A. Barry and G. W. Clarke. April 6th.

8,286. "Improved variable speed dynamo for motor-car lighting." C. T. Lehmann, W. Rose-Harvey and G. Inrig. April 6th.

8,288. "Improvements in overhead electric cables." W. Warmbold. April 6th.

8,294. "Magnetic clutch." Dutheil, R. Chalmers & Co. (Date applied for under Sec. 91 of the Act, April 6th, 1909, being date of application in France.) April 6th. (Complete.)

8,298. "New method of and means for the application of electricity to the deposition of metals or their alloys, or the making of coloured coatings on metals." A. S. Bowley. April 6th.

8,332. "Improvements in telephone system and individual transmitter." C. L. Chisholm. April 6th. (Complete.)

8,341. "Improved incandescence filament or body and process for manufacturing same." E. Cervenka. (Date applied for under Sec. 91 of the Act, Oct. 23rd, 1909, being date of application in Germany.) April 6th. (Complete.)

8,363. "Improvements in electrically-driven vehicles." A. F. Batchelder. (Date applied for under Sec. 91 of the Act, April 7th, 1909, being date of application in United States.) April 7th. (Complete)

8,371. "Improvements in connection with installation of electric incandescent lamps connected in series." E. Booth and N. R. Booth. April 7th.

8,375. "Improvements in electrical switches." J. H. Tucker. April 7th.

8,380. "Improvements in arc lamps." R. H. Burkitt. April 7th.

8,409. "Improvements in the ventilation of dynamo-electric machines." Siemens Bros. Dynamo Works, Ltd., and W. Parker. April 7th. (Complete.)

8,410 "Improvements in armature windings for dynamo-electric machines." Siemens Bros. Dynamo Works, Ltd. (Siemens Schuckertwerke G.m.b.H., Germany.) April 7th. (Complete.)

8,411. "Improvements in or relating to electric searchlights." Siemens-Schuckert Werke G.m.b.H. (Application for Patent of Addition to No. 12,556, 1908. (Date applied for under Sec. 91 of the Act, April 8th, 1909, being date of application in Germany.) April 7th. (Complete.)

8,418. "Improvements in or in connection with electric switches." A. P. Lundberg, G. C. Lundberg and P. A. Lundberg. April 7th. (Complete.)

8,444. "Improvements relating to conduits and conduit fittings for electric wiring." W. Wilkinson. April 7th.

8,459. "Improvements in electrical maximum demand indicators and like apparatus." H. S. Hatfield. April 7th.

8,460. "Improvements in double-break electric switches." Sykes and Sugden, Ltd., and A. Sugden. April 8th.

8,477. "Improvements in ceiling roses, electric light pendant fittings, and the like." L. M. Waterhouse. April 8th.

8,492. "Improved electrical advertising arrangement." E. Brown and H. A. Brown. April 8th.

8,507. "Improvements in or relating to search-lights or projectors." Siemens Bros. Dynamo Works, Ltd. (Siemens-Schuckertwerke G.m.b.H., Germany.) April 8th. (Complete.)

8,510. "Improvements in or relating to electric arc lamps." H. T. Harrison. April 8th.

8,513. "Improved electric lamp and process for manufacturing same." A. Hebden. April 8th.

8,551. "Improvements in telephone switchboards." Siemens Bros. & Co., Ltd., and F. Hird. April 8th. (Complete)

8,556. "Improvements in systems of electric power distribution." M. Cattori. April 8th.

8,559. "New or improved method of and apparatus for charging electric accumulators and or maintaining them in a charged condition." G. J. Lemmens. April 8th.

8,563. "Improvements in and relating to the feeding of relatively low voltage lamps or other translating devices from a network of higher voltage." L. New. (Date applied for under Sec. 91 of the Act, May 18th, 1909, being date of application in France.) April 8th. (Complete.)

8,573. "Electric fire and burglary contact." J. P. Woodey. April 9th.

8,610. "Improvements in telegraphy." L. M. Potts. (Date applied for under Rule 13, June 29th, 1909. An invention comprised in application No. 15,167, dated June 29th, 1909.) April 9th. (Complete.)

8,621. "Improvements relating to the control of alternating electric current induction motors." Allgemeine Elektricitats Ges. (Date applied for under Sec. 91 of the Act, April 10th, 1909, being date of application in Germany.) April 9th. (Complete.)

8,644. "Improvements in the electrolytic deposition or precipitation of metals." H. E. Dolphin and E. Casper. April 9th.

EXPIRING PATENTS.

We are informed by Messrs. W. P. Thompson & Co., Electrical Patent Agents, of 285, High Holborn, W.C., that 490 patents granted on applications which were filed during 1895 have been maintained for their full term—viz., 14 years. Only 90 of these patents relate to electrical matters, and as these are of considerable value, we give short abstracts of them below:—

1,553. January 2nd, 1896. "Electric switches." R. Pearson, London. Circuit closers especially adapted for use in connection with railway signals to indicate that the signal has been moved. The semaphore arm carries a tube in which are platinum contacts suitably connected up to the box. On a movement of the arm a globule of mercury in the tube momentarily makes contact, so signalling to the box.

2,166. January 29th, 1896. "Lightning dischargers." Siemens Bros. & Co., Ltd., Westminster. (Siemens & Halske, Berlin.) Lightning arresters are formed of two rods mounted on insulators, which are horizontal in their lower portions, then vertically parallel in their central portions, and finally upwardly divergent. The upper parts of the rods are supported by insulators.

2,248. January 31st, 1896. "Electric cut-outs." H. Hirst, London. The object is to prevent the formation of an arc when the fuse is ruptured. An insulating bridge piece is fitted between the terminals, and the wire passed through or around it in an irregular manner. Each fuse is separated from its neighbour by a bridge piece.

2,249. January 31st, 1896. "Electric cut-outs." H. Hirst, London. The object is to prevent the formation of an arc when the fuse is ruptured. The fuse wire is threaded or interwoven with an insulating material, such as asbestos, so forming an irregular course. The wires may be single or multiple.

2,591. February 4th, 1896. "Telephonic apparatus." E. W. Smith, Chelsea, and New Phonopore Telephone Co., Ltd., London. Relates to telephoning along lines simultaneously used for telegraphic or other purposes. The call is sent by a vibrating reed acted upon by the core of a phonopore, in which the primary is arranged in connection with a key and the switch lever so that, in the normal condition, it is short-circuited, but when the key is moved a call is sent. When used for signalling along two lines, a commutator is employed for connecting either line to the phonopore, the other line being connected to a single coil with condensers in circuit.

3,093. February 11th, 1896. "Controlling electromotors, &c." J. Devonshire, London. (W. H. Knight and J. W. Darley, of U.S.A.) Relates to a device for changing two or more electric motors or similar machines from series to parallel connection, the operation being carried out in a number of stages, and a resistance inserted into the circuit when the successive changes are made. The apparatus consists of a switch cylinder, carrying contacts numbered 1 to 28, and a rheostat cylinder carrying a stepped contact plate, geared together so that the rheostat cylinder makes five revolutions for every one of the switch cylinder.

4,238. February 25th, 1896. "Dynamo-electric machines." J. Devonshire, London. (W. H. Knight, U.S.A.) Armatures of the drum type are wound with a number of separate coils, each of which has the form of a six-sided figure, of which the two halves lie in different but parallel planes, and are united by a portion approximately radial to the circumference.

4,805. March 3rd, 1896. "Magnetic separators." J. P. Wetherill, Pennsylvania, U.S.A. Minerals, such as limonite, siderite, rutile, which have a low magnetic susceptibility, are separated from associated gangue. The finely powdered ore is fed in a uniform layer upon travelling bands which pass over pulleys and magnets. The electromagnets have tapering pole-pieces, which are adjustable towards or away from each other. Beneath the pole-pieces are three receptacles, a middle one for receiving the non-magnetic materials, and two outer receptacles for receiving the magnetic material.

5,274. March 9th, 1896. "Electro-deposition." A. S. Smith, T. A. Smith R. J. Smith and S. Smith, all of Walsall. Relates to plating articles with a bright surface in one operation. The vat is formed in the usual manner, and has metallic rods along the sides connected to the positive pole of the source of electricity, and carrying anodes. The vessel is charged with the electrolyte as shown. A perforated octagonal barrel, formed of wooden staves, is carried by copper hangers or brackets from a rod, which is itself suspended by rods. One of the octagonal sides is removable, and the articles to be plated are inserted therein, after which the side is put back and secured, and the whole lowered into the liquid. By the rotation of the barrel during working, the articles are constantly being rolled over and rubbed against one another and against the contacts, the result being that they are brightened and require no further polishing when removed from the bath.

(To be continued.)

PUBLISHED SPECIFICATIONS.

Copies of any of the Specifications in the following list may be obtained of Messrs. W. P. Thompson & Co., 285, High Holborn, W.C., and at Liverpool and Bradford; price, post free, 9d. (in stamps).

1908.

Electrical Distribution Systems. J. P. Crouch and J. Etchells. 27,212. December 15th.

1909.

Alternating-Current Dynamo-Electric Apparatus. British Thomson-Houston Co. (Allgemeine Elektricitäts Ges.) 694. January 11th. (Application for Patent of Addition to No. 23,288, 1902.)

Electric Motor Converters. Bruce Peebles & Co. (O. S. Bragstad and J. la Cour, Germany.) 6,069. March 1sth.

Electric Power Transmission Systems. C. A. Parsons, G. G. Stoney and A. H. Law. 6,177. March 15th.

Automatic Electric Switches. E. R. Grote. 6,405. March 17th.

Electric Motor Control. British Thomson-Houston Co. (General Electric Co.) 6,564. March 18th.

Electric Energy Meters. British Thomson-Houston Co. and C. R. d'Arcy. 6,565. March 18th.

Electric Resistance Units. British Thomson-Houston Co. (General Electric Co.) 6,674. March 19th.

Electric Furnaces. J. H. Reid. 6,820. March 22nd. (Date applied for under International Convention, August 22nd, 1908.)

Electric Light Reflectors for Concentrating Light. G. F. Allom. 6,836. March 22nd.

Hand-Operated Magneto-Electric Machines. Siemens Bros. & Co., C. R. Riber and H. W. F. Ireland. 6,877. March 22nd.

Generation, Storage and Use of Electric Power, particularly for Lighting Purposes. C. B. Walker. 6,916. March 23rd.

Electric Motor Control. British Thomson-Houston Co. (General Electric Co.) 7,114. March 24th.

Electrical Apparatus for Medical and Other Purposes, and Articles to which such Apparatus may be Applied. G. Bryant and C. H. Ivinson. 7,198. March 25th.

Systems of Electric Motor Control. British Thomson-Houston Co. (General Electric Co.) 7,230. March 25th.

Electric Capstans. Hydraulic Engineering Co. and N. B. Ellington. 7,408. March 27th.

Electric Switches. G. W. Hawker. 9,456. April 21st.

Electric Systems for Power Transmission. Allgemeine Electricitäts Ges. 11,4 0. May 13th. (Date applied for under International Convention, May 13th, 1908. Application for Patent of Addition to No. 11,389, 1909.)

Third Rails for Electric Traction Systems. C. A. Bluhm. 12,254. May 24th.

Clutches for Electric Automobiles and the like. C. Meranville de Sainte Claire. 14,407. June 8th. (Date applied for under International Convention, November 16th, 1908. Application for Patent of Addition to No. 18,234, 1909.)

Electric Systems for Power Transmission. Allgemeine Electricitäts Ges. 14,798. June 11th. (Date applied for under International Convention, June 12th, 1903. Application for Patent of Addition to No. 11,389, 1909.)

Means for Giving an Initial Impulse to Magneto-Electric Sparking Machines used in connection with Internal-Combustion Engines. G. Braud. 13,908. June 11th.

Collector Shoes or Skates for Electric Traction Systems. R. J. Houghton, P. Allman and W. T. Gray. 15,371. July 1st. (Date applied for under Rule 13, June 2nd, 1909.)

Generators for Wireless Telegraphy and Telephony with Continuous Oscillations. E. Huth. 15,891. July 7th.

Substance for Igniting Purposes. Kunheim & Co. 16,211. July 12th. (Date applied for under International Convention, January 25th, 1909.)

Ignition Devices for Use with Burners. Naamlooze Vennootschap Bergen op Zoomsche Metaalwarenfabriek and R. Milo. 16,258. July 13th.

Intercommunication Telephone Instruments. J. A. Romer. 17,107. July 22nd.

Electric Incandescent Lamp with Metal-Filament Loops. H. Kuzel. 17,627. July 29th. (Date applied for under International Convention, January 4th, 1909. Request under Sec. 19 not granted.)

Electrical Heating Means for Water-Bottles and other Fluid Receptacles. H. W. Christian. 18,940. August 17th.

Electric Switches. A. P. Lundberg, G. C. Lundberg and D. A. Lundberg. 22,897. October 7th.

Electric Switches. W. A. Morse. 25,182. November 1st.

Provisions for Electrically Heating Apparatus for Incubating, Propagating and Cultivating Micro-Organisms and Sterilising. C. E. Hearson. 27,909. November 30th.

Electric Furnaces. J. A. Hay. 27,972. November 30th. (Date applied for under International Convention, June 19th, 1908.)

Electrical Burglar-Alarms. R. Trautmann. 28,638. December 7th.

Rotary Converter Dynamo-Electric Machines. Siemens Bros. Dynamo Works. (Siemens Schuckertwerke Ges.) 29,188. December 14th.

Revolving Magnets for Dynamo-Electric Machines. Allmanna Svenska Elektriska Aktiebolaget. 30,176. December 14th. (Date applied for under International Convention, July 12th, 1909.)

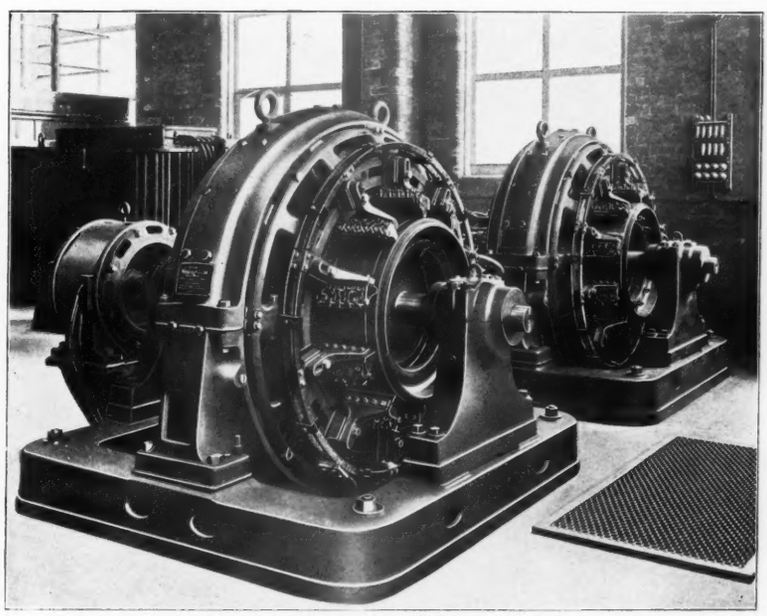
1910.

Method of Working Arc Lamps in Series with Incandescent Lamps. A. Heimann and W. Schaffer. 748. January 11th. (Date applied for under International Convention, January 15th, 1909.)

The British Westinghouse Electric and Mfg. Co., Ltd.

MANCHESTER AND LONDON.

Rotary Converters



(Photo 6465.)

THE Rotary Converter is the best machine for converting alternating current at any frequency up to 60 cycles to direct current or vice versa.

The rotary converter, with its step-down static transformer, is far more reliable than the motor generator or the motor converter. The alternating current in the rotary is at a low pressure, and the factor of safety can be made high, whereas, in the case of a high-pressure motor-generator or motor-converter the factor of safety of the insulation is necessarily very much lower than in a static transformer.

KEEP FOR REFERENCE.

The British Westinghouse Electric and Mfg. Co., Ltd.

The Advantages of the Rotary Converter

EFFICIENCY.—In its efficiency a rotary converter with its transformer beats all other types of converting machinery by at least 2 per cent.; and in sizes up to 300 kw. by 4 per cent.; the saving in power, capitalised, pays for the machine.

COMMUTATION.—The British Westinghouse rotary commutates perfectly on heavy overloads. No delicate adjustment of the brushes is necessary.

SYNCHRONISING.—The synchronising power of a correctly-designed rotary converter is greater than that of any other class of machine. There is no hunting with British Westinghouse rotary converters.

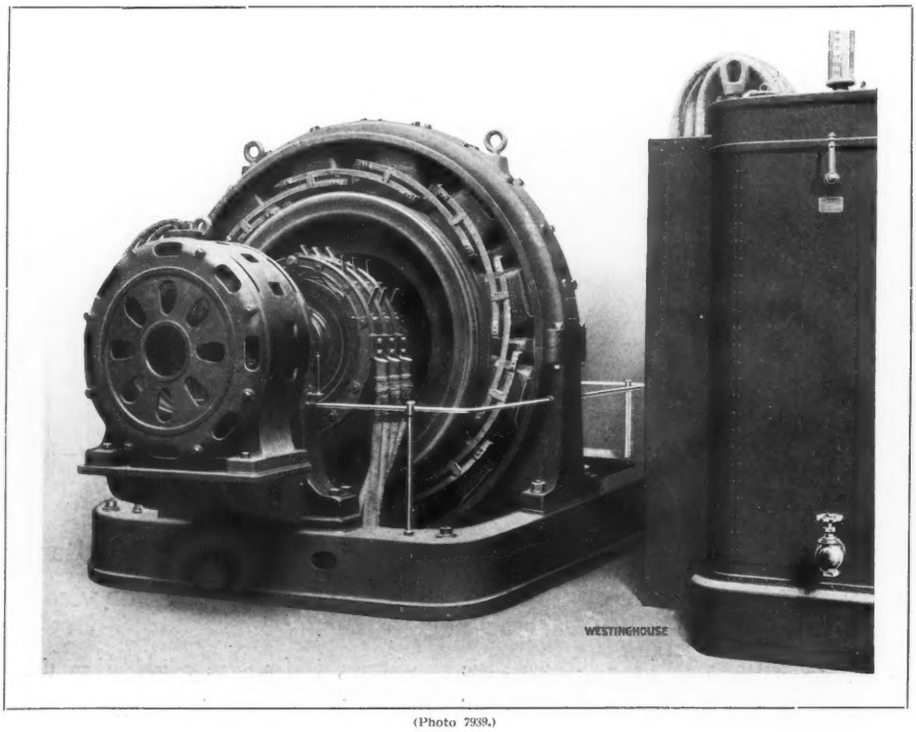
STARTING.—Small sizes up to 500 kw. are self-starting, and do not need to be synchronised.

OVERLOAD.—They may be run continuously on 50 per cent. overload without the slightest injury.

VOLTAGE REGULATION.—Any kind of voltage adjustment or regulation can be obtained with these machines; they may be used to balance a three-wire system automatically.

POWER-FACTOR.—The rotary converter will run at unity power-factor, and may be arranged to supply a leading current when desired.

Typical Installations

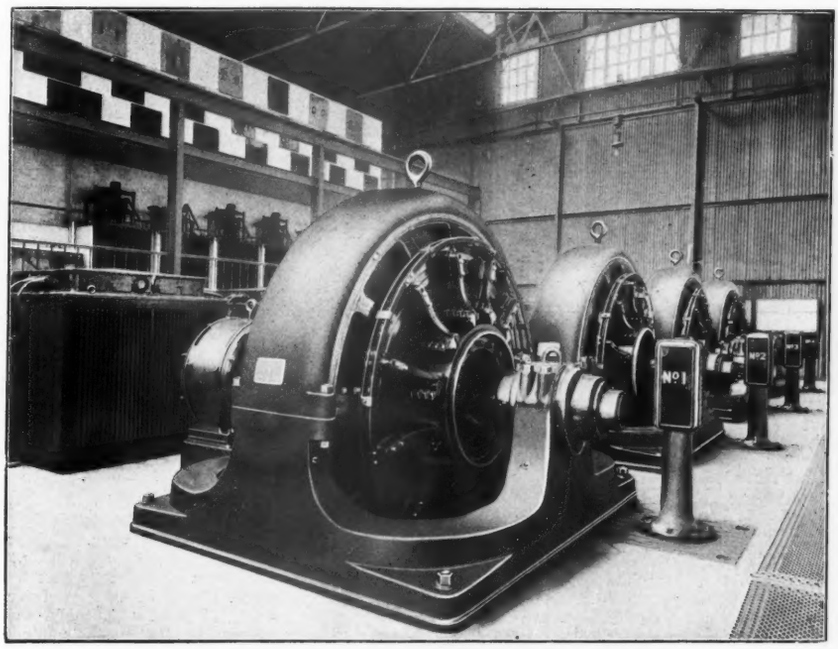


(Photo 7939.)

The above illustration shows one of two 25-period rotaries supplied to the Birmingham Corporation, the capacity of each being 1,500-kw., 400/500-volts, 3,150-amps, 250-r.p.m. These rotaries take 50% overload for two hours, and 100% momentarily. The measured efficiency is 97·5%., and efficiency of each rotary, together with its transformer, over 95·5%.

The British Westinghouse Electric and Mfg. Co., Ltd.

Typical Installations—continued.



(Photo 4825A.)

Pandon Dene Sub-Station, North-Eastern Railway.

The electrical section of the North-Eastern Railway, which extends north-east and north-west from Newcastle-on-Tyne to Tynemouth and Ponteland respectively, is fed from six sub-stations. These sub-stations are equipped with static transformers, rotary converters and switchgear, all of Westinghouse manufacture.

The illustration shows the four converters installed at the Pandon Dene Sub-station; there being three similar machines both at Cullercoats and Wallsend, two at Benton, and one each at Kenton and Percy Main. The rotaries are each of 800-kw., 600-volt, and operate at 40-cycles. They are designed to take 50% overload for two hours, and 100% for two minutes.

The total capacity of the rotary converters on this contract is thus 11,200-kw.

Westinghouse Rotaries aggregating 182,000 kw. already installed in Great Britain alone.

The continued popularity is largely owing to their high efficiency, perfect commutation, to absence of hunting, strong mechanical construction, ease of installation, and ease of inspection.

The British Westinghouse Electric and Mfg. Co., Ltd.

An Instructive Comparison

It is instructive to consider the cost of a large substation equipped alternatively with rotary converters and motor generators. We have recently completed for the Birmingham Corporation two large 25-period rotary converters, the capacity of each being 1500 kw., 400/500 volts, 3150 amps., 250 r.p.m. The rotaries referred to will carry an overload of 50 per cent. for two hours, and 100 per cent. momentarily, so that when running on a variable load they could take for an all-day run a much heavier overload than could with safety be put on motor generator sets of 1500 kw. normal rating. Consequently, a load requiring four 1500 kw. motor generators could be successfully dealt with by three 1500-kw. rotaries. A substation with rotary converters would therefore be much cheaper than if equipped with motor generators, as, allowing in each case one spare machine, four rotaries with transformers would, due to their large overload capacity, be equivalent to five motor generators.

The power required to run three such rotaries light would not exceed 60 kw., whereas the power required to run four 1500 kw. motor generators light would be not less than 350 kw. The power saved through the greater efficiency of the rotaries would be very considerable, and even taking its cost at a low figure, the saving would soon repay the initial cost of the plant.

Rotaries in operation

From the Chief Electrical Engineer, Willesden District Council.

May 1st, 1909.

Re 300 Kw. ROTARY CONVERTER.

Dear Sirs,—I have now had opportunity of taking out the figures obtained from tests recently made on the above machine. As you know, the guaranteed figures for the over-all efficiency of the transformer and rotary were as follows:—¼ load, 85%; ½ load, 91%; ¾ load, 93%; full load, 94%; 25% overload, 94%. The actual figures obtained were as follows:—¼ load, 87·69%; ½ load, 91·73%; ¾ load, 93·83%; full load, 94·67%; 25% overload, 94·17%; these figures being obtained with a power factor varying between ·93 at ¼ load to ·97 at 1¼ load. I am satisfied that the instruments used were correct, having been independently calibrated against standard instruments and certificates of their correctness supplied to me. The tests for temperature rise, which were also carefully carried out proved satisfactory in every way, and were well below the guaranteed figures throughout.

The machine has done everyday load work since the beginning of January, and has proved quite satisfactory in every respect.

Yours faithfully,

(Signed) J. G. BRUCE,
Electrical Engineer.

From the Engineer and Manager to the West Ham Corporation Electric Supply.

22nd September, 1908.

Dear Sirs,—I have much pleasure in informing you that the two 250-kw., 50-period, 2-phase rotaries supplied by you to our order, for Messrs. Moreland & Sons, have given the greatest satisfaction. The efficiency, taken by input and output, and not calculated, was about one per cent. better than that tendered.

The machines took the place of a steam electric power plant which Messrs. Moreland's were scrapping, and the converters had to be in commission before the old plant could be shut down. They were consequently erected on timber baulks in an odd corner of the power house, and under these unfavourable conditions, among the concrete and brick dust caused by the removal of the steam plant, ran for many weeks, day and night, practically without attendance, as it was not our practice to employ rotary substation attendants; what little attention they require is arranged with the consumer's man who sees to the motors, our man calling in say twice a day.

The rotaries are self starting, which is necessary if unskilled attendance is employed.

Yours faithfully,

(Signed) A. HUGH SEABROOK,
Engineer and Manager.

The British Westinghouse Electric & Mfg. Co., Ltd.

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LONDON: Westinghouse Building, Norfolk Street, Strand, W.C.

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Head Office and Works:

MANCHESTER: Trafford Park.

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GLASGOW . . . . . 17, St. Vincent Place.
MANCHESTER . . . . Commercial Buildings, 15, Cross Street.
NEWCASTLE-ON-TYNE . Ward's Buildings, High Bridge.
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Telegraphic Address for all Branch Offices: "Multiphase" (with name of town).

For South Africa:—

JOHANNESBURG . . . . . Consolidated Building. *Tel. Address:* "Converter, Johannesburg."

For Agents and Allied Companies, see other Lists.

Printed by WILLIAM CATE, LTD., Hogarth House, Bouverie Street, E.C., and Published by the Proprietors, H. ALABASTER GATEHOUSE & CO., at 4, Ludgate Hill, London.